

P.6103 A

ISSN 0181-1568

CRYPTOGAMIE

ALGOLOGIE

TOME 17 Fascicule 3 1996



1-3 (10) 1996



CRYPTOGAMIE

Algologie

ANCIENNE REVUE ALGOLOGIQUE
Fondée par P. Allorge et G. Hamel en 1922

Directeur de la publication : Dr. Hélène Bischler-Causse

Rédaction : Dr. Bruno de Reviers

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Adresse électronique : reviers@mnhn.fr

Editeur : A.D.A.C. — 12, rue Buffon F-75005 Paris

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TARIFS DES ABONNEMENTS Tome 17, 1996

CRYPTOGAMIE comprend trois sections : Algologie, Bryologie-Lichénologie, Mycologie.

Pour une section : France : (350 FF ht) 357, 35 FF ttc Etranger : 380,00 FF

Pour les 3 sections : France : (950 FF ht) 970,00 FF ttc Etranger : 1050,00 FF

VAT registration number : FR29302655170

Paiement par chèque bancaire ou postal à l'ordre de A.D.A.C. — CRYPTO GAMIE (CCP La Source 34 764 05 S), adressé à : A.D.A.C. 12, rue Buffon, F-75005 Paris.

Cryptogamie, Algologie est indexé par *Aquatic Sciences Fisheries Abstracts Part 1. Biological Abstracts, Chemical Abstracts, Current Contents, Marine Science Contents Tables (F. A. O.)*. Publications bibliographiques du C.N.R.S. (Pascal).

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SUR UNE ESPÈCE JAPONAISE DE *CHONDRUS* (GIGARTINACEAE, RHODOPHYTA) ACCIDENTELLEMENT INTRODUITE DANS L'ÉTANG DE THAU (FRANCE, MÉDITERRANÉE)

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ABSTRACT — Probably in 1993 or early 1994, further to illicit importations of oysters (*Crassostrea gigas*) from North Japan, an asiatic *Chondrus*, *C. giganteus* forma *flabellatus*, has accidentally been introduced in the Mediterranean sea where the genus was hitherto unknown. In september 1995, this alga was common on hard substrates along the north coast of Thau lagoon (Hérault, France), and the majority of thalli were in reproduction (tetrasporophytes, male plants and female plants with carpogonial branches and carposporophytes). The mediterranean specimens are described. The implications of this acclimatization in Thau lagoon and the possible spread of this *Chondrus* elsewhere in Europe are discussed.

RÉSUMÉ — Probablement en 1993 ou au début de 1994, à la suite d'importations illicites d'huîtres *Crassostrea gigas* du Nord du Japon, une espèce asiatique de *Chondrus*, *C. giganteus* forma *flabellatus*, a été accidentellement introduite en Méditerranée où le genre était inconnu jusqu'à présent. En septembre 1995, l'algue était commune sur les substrats durs du littoral nord de l'étang de Thau (Hérault, France) et la plupart des thalles étaient fertiles (tétrasporophytes, mâles, femelles avec rameaux carpogoniaux et carposporophytes). Les spécimens méditerranéens sont décrits. Les implications de cette acclimatation dans l'étang de Thau et la possible dissémination de ce *Chondrus* ailleurs en Europe sont discutées.

MOTS CLÉS : *Chondrus giganteus* f. *flabellatus*, espèce introduite, France, Méditerranée.

INTRODUCTION

L'aquaculture, notamment la conchyliculture, et le trafic maritime, via les salissures et les opérations de déballastage, sont les deux principaux vecteurs d'introduction accidentelle d'espèces marines (Zibrowius, 1991 ; Ribera & Boudouresque, 1995). Première zone ostréicole méditerranéenne par sa production (13 000 t an⁻¹, Trousselier *et al.*, 1991), l'étang de Thau (Hérault, France) s'est révélé comme un site majeur d'introduction d'espèces (Verlaque, 1994, 1996). Notamment, depuis que

l'essentiel de sa production est assuré par l'huître *Crassostrea gigas* Thunberg, une espèce exotique acclimatée dans l'Atlantique mais qui ne permet pas le captage de naissain en Méditerranée. Entre 1971 et 1976, un contingent important d'algues asiatiques est arrivé à Thau lors d'importations massives et directes de naissains du Japon (Grizel & Héral, 1991). Depuis cette période, les seuls sites d'approvisionnement officiellement autorisés sont des zones de captage atlantiques.

En 1994, lors d'une étude sur la physiologie des algues des parcs ostréicoles de Thau, l'un d'entre nous (Latala, 1996) a récolté plusieurs espèces asiatiques inconnues, jusqu'à ce jour, en Méditerranée. Dans ce nouveau contingent d'algues introduites en Europe, la première espèce qu'il nous paraît important de signaler et de décrire est le *Chondrus giganteus* Yendo f. *flabellatus* Mikami.

MATÉRIEL ET MÉTHODES

Toutes les observations de terrain et les récoltes ont été réalisées en septembre 1994 et 1995, sur le littoral nord de l'étang de Thau, entre les localités de Mèze et de Bouzigues (43°26'N, 3°37'E). Thau est une lagune littorale profonde (4 m en moyenne et 10 m au maximum, hormis le gouffre de la Bise) où la température de l'eau avoisine 4°C, en janvier-février, et 27°C, en juillet-août. La salinité y reste élevée toute l'année (min. 27.35 g l⁻¹ ; max. 40.36 g l⁻¹) en raison d'échanges permanents avec la mer au travers de trois canaux de communication (Tournier *et al.*, 1983). Les variations du niveau de l'eau, essentiellement liées aux marées barométriques et aux vents, n'excèdent pas quelques dizaines de centimètres. Le matériel récolté a été fixé dans de l'eau de mer formolée à 4 %. Les spécimens étudiés ont été déposés dans l'Herbarium du Laboratoire LBMEB, Faculté de Luminy, Marseille, avec les références suivantes : H.2540-2542, tétrasporophytes, étang de Thau, septembre 1994 ; F. 1361-1364 et H.2543-2575, étang de Thau, 27 septembre 1995 (F. 1361, thalles stériles ; F.1364, H.2543-H2560, tétrasporophytes ; F.1362, H.2561-2568, gamétophytes mâles ; F.1363, H.2569-H2575, gamétophytes femelles). Les coupes ont été réalisées à l'aide d'une lame de rasoir puis colorées dans une solution aqueuse de bleu d'aniline 1 % (v/v), rincées, acidifiées avec une goutte d'HCl 1N (1 %, v/v), à nouveau rincées puis montées dans du sirop Karo® à 20 % dans l'eau de mer (v/v). Les photographies au microscope ont été réalisées avec un Nikon Optiphot-2®. Les mesures ont été faites sur le matériel fixé et sur des cellules au contenu non rétracté.

RÉSULTATS

L'algue a été découverte dans l'étang de Thau en 1994. En septembre 1995, elle était commune et fertile, entre la surface et un mètre de profondeur environ, sur les enrochements situés entre Mèze et Bouzigues.

Caractéristiques de l'appareil végétatif

Le *Chondrus* récolté à Thau présente une grande diversité de formes (Figs 1-8). Le thalle aplati et cartilagineux est de couleur rouge brunâtre à noirâtre. L'algue, fixée au substrat (roche ou coquilles d'huîtres) par un petit disque charnu de quelques millimètres de diamètre, se compose de plusieurs axes dressés plus ou moins

développés (jusqu'à une vingtaine par individu) (Fig. 2). Les dimensions maximales des axes sont plus grandes chez les tétrasporophytes (hauteur : 9.5 à 21 cm, largeur : 0.5 à 12.5 cm, Figs 1-6) que chez les gamétophytes mâles (hauteur : 6 à 14.5 cm, largeur : 0.5 à 4.5 cm, Fig. 7) ou femelles (hauteur : 9.5 à 10 cm, largeur : 0.5 à 2.5 cm, Fig. 8). Le port de l'algue est flabellé. L'épaisseur des axes peut atteindre 720-760 μm au niveau de leur base cunéiforme et plus ou moins évasée. La ramification est subdichotome à angles aigus ou obtus. Le nombre de dichotomies successives varie de 4 à 8 suivant les individus. Les apex, simples ou bifurqués, peuvent être graduellement effilés, arrondis ou bien tronqués. Les marges du thalle et, sur certains grands individus, la surface portent un nombre variable de proliférations, rétrécies à leur point d'insertion, simples et spatulées ou cordiformes ou encore plus ou moins ramifiées comme les axes. En coupe longitudinale, le thalle se compose d'un cortex de 7 à 9 rangées de cellules oblongues de taille décroissante (diamètre : 4 à 2 μm) disposées en files plusieurs fois dichotomes perpendiculaires à la surface du thalle, d'une couche sub-corticale de cellules subglobulaires étoilées et enfin d'une zone médullaire de cellules longues et fines (longueur \times diamètre : 40-124 \times 7-18 μm) disposées en files longitudinales et connectées entre elles par des synapses secondaires (Figs 9-11).

Caractéristiques des organes reproducteurs

À la fin du mois de septembre 1995, la plupart des thalles récoltés étaient fertiles. L'algue est dioïque. Sur 45 individus examinés, la répartition entre gamétophytes et tétrasporophytes était proche de 1 : 1 (21 tétrasporophytes, 9 mâles, 10 femelles et 5 indéterminés). Les caractéristiques des organes reproducteurs restent inchangées quelles que soient les variations morphologiques du thalle (largeur, ramification, nombre de proliférations).

Les sores de tétrasporocystes forment des taches rouges ovales, souvent confluentes, sur presque toute la surface du thalle (Figs 12-13). Chez tous les tétrasporophytes fertiles récoltés, la différenciation en chaîne des tétrasporocystes s'effectue toujours à partir de n'importe quelle cellule médullaire. En coupe, la masse de tétrasporocystes occupe la totalité de la *medulla* (Figs 14-16). À maturité, les tétrasporocystes cruciés atteignent 32 à 52 μm de long et 20 à 38 μm de diamètre.

Les thalles mâles fertiles se distinguent grâce à la couleur plus claire des proliférations et des ramules terminaux qui portent les sores d'organes reproducteurs (Fig. 17). Les spermatocystes mesurent 7.5 μm de long et 2 à 2.5 μm de diamètre et se différencient seuls ou en paires sur les cellules corticales superficielles. Chaque spermatocyste produit latéralement une spermatie ovoïde uninucléée de 2 à 2.5 μm de diamètre et 4 à 5 μm de long (Fig. 18).

Les thalles femelles fertiles portent dans leur moitié supérieure des cystocarpes à différents stades de développement (Fig. 19). Les plus jeunes se situent dans les portions terminales et les petites proliférations latérales alors que les plus âgés se rencontrent plus bas sur les axes. Les rameaux carposoniaux, observés sur des coupes longitudinales de ramules jeunes, naissent chacun sur une cellule-support différenciée dans le cortex interne et connectée aux cellules végétatives voisines par des synapses secondaires (Fig. 20). Une file cellulaire stérile est également visible sur certaines cellules-supports (Fig. 21). La fécondation et les premiers stades du développement du carposporophyte n'ont pas pu être observés. Par la suite, les filaments gonimoblastiques s'insinuent entre les cellules médullaires. Les jeunes cystocarpes sont globulaires et occupent toute la *medulla* (Fig. 22). Les carpospores se développent latéralement ou

en position terminale sur les filaments gonimoblastiques (Fig. 23). A maturité, les cystocarpes deviennent ocellés et plus ou moins circulaires (diamètre 2.5 à 2.9 mm) et les carpospores atteignent 22 à 42 μm de long et 16 à 29 μm de diamètre (Fig. 24). Leur libération s'effectue par désorganisation de la couche corticale sans différenciation d'ostiole.

DISCUSSION

L'organisation de l'appareil végétatif, les tétrasporocystes cruciés unis en chaînes et groupés au centre de la *medulla* et enfin le carposporophyte dépourvu d'enveloppe périphérique différenciée permettent d'attribuer l'algue découverte à Thau au genre *Chondrus* Stackhouse. C'est la première fois que la présence d'un *Chondrus* est établie en Méditerranée. En effet, bien que signalé dans le bassin oriental (Haritonidis & Tsekos, 1976), l'algue atlantique *Chondrus crispus* Stackhouse, unique représentant européen du genre, est très probablement absente de Méditerranée (Athanasiadis, 1987). A Thau, les dimensions importantes de l'algue, l'abondance des proliférations observée chez certains individus et enfin l'aspect ocellé des cystocarpes mûrs ne s'accordent pas avec *C. crispus* (cf. Taylor & Chen, 1973 ; Dixon & Irvine, 1977). Compte-tenu de l'origine asiatique des précédentes introductions dans l'étang de Thau, nous nous sommes donc orientés vers les espèces du Pacifique et notamment vers celles des principaux pays exportateurs d'huîtres vivantes, c'est-à-dire la Corée et le Japon. Dans cette région d'Extrême-Orient, sept ou huit taxons de *Chondrus* sont reconnus à ce jour (Lee & Kang, 1986 ; Noda, 1987 et Yoshida *et al.*, 1990). Parmi ceux-ci, les seuls à posséder un thalle aplati, large, plus ou moins subdichotome et prolifère sont : *C. giganteus* Yendo, *C. nipponicus* Yendo et *C. ocellatus* Holmes, trois algues proches et très polymorphes, considérées longtemps comme trois formes du *C. ocellatus* (Okamura, 1929-1932), et discriminées aujourd'hui principalement sur des bases anatomiques (Noda, 1987 ; Brodie *et al.*, 1991, 1993, 1994). Certains de nos spécimens rappellent, par leur forme, le *Chondrus ocellatus* f. *crispus* d'Okamura (1929-1932, pl.292, fig. 2), une algue japonaise d'abord mise en synonymie avec *C. crispus* (Mikami, 1965) puis, récemment, avec *C. nipponicus* (Brodie *et al.*, 1991, Masuda & Hashimoto, 1993), d'autres ressemblent aux illustrations du *C. ocellatus* données par Noda (1987). Cependant, l'algue de Thau ne s'accorde avec aucun de ces deux taxons. D'une part, elle diffère du *C. nipponicus* tel qu'il a été redécrit récemment, par sa taille plus grande, son port et surtout par ses cystocarpes mûrs qui forment des ocelles à la surface du thalle. D'autre part, elle se distingue aisément du *C. ocellatus* par la différenciation constante de ses tétrasporocystes à partir de n'importe quelle cellule de la *medulla* et non uniquement à partir de celles de la périphérie. En définitive, le seul taxon morphologiquement et anatomiquement compatible avec nos échantillons est la forme *flabellatus* Mikami du *Chondrus giganteus* Yendo (Tableau 1). Aucune divergence majeure n'a pu être relevée entre les deux algues. Les convergences morphologiques observées entre le *Chondrus* de Thau et les trois taxons asiatiques résultent sans doute des liens étroits de parenté qui les unissent.

A Thau, la découverte du *Chondrus giganteus* dans un secteur pourtant très étudié auparavant (Ben Maiz, 1986 ; Gerbal, 1994) signifie que des immersions d'huîtres en provenance d'Asie ont dû avoir lieu ces dernières années (Verlaque, 1996). La présence, sur les fonds meubles proches de notre zone de récolte, de poches ostréicoles colonisées par une flore exotique inconnue dans l'étang corrobore cette

Espèces et Sources	<i>C. ocellatus</i> Holmes Brodie <i>et al.</i> , 1993	<i>C. nipponicus</i> Yendo Brodie <i>et al.</i> , 1991, 1993	<i>C. giganteus</i> Yendo <i>f. flabellatus</i> Mikami, 1965	<i>Chondrus</i> de Thau Matériel étudié
Ramification	dichotome/subdich.	dichotome/subdich	subdichotome	subdichotome
Hauteur	1.5 - 20 cm	5 - 12	10 - 20	6 - 21
Largeur des axes	< 0.4 - 3.5 cm	0.2 - 2	max. 2 - 8	0.5 - 12.5
Cellules longueur médullaires diamètre	75 - 133 µm 2.5 - 12 µm	35 - 100 2.5 - 12	110 - 120* 9 - 15*	40 - 124 7 - 18
Sores à tétrasporocystes	sur tout le thalle, sauf extrême base	partie inférieure du thalle et proliférations	sur tout le thalle, sauf extrême base	sur tout le thalle, sauf extrême base
Différenciation des tétrasporocystes	sur le bord externe de la medulla	dans toute la medulla	dans toute la medulla	dans toute la medulla
Localisation à maturité	près d'une face du thalle	centrés sur la medulla	centrés sur la medulla	centrés sur la medulla
dimensions longueur diamètre	27.5 - 35 µm 20 - 25 µm	30 - 46.5 25 - 32.5	50 37.5	32 - 52 20 - 38
Cystocarpes	près des apex ou plus bas	près des apex, souvent sur les bords	dispersés sur le thalle	moitié supérieure du thalle
Aspect à maturité	ocellé, saillant sur une face	hémisphérique, saillant sur une face	ocellé	ocellé
Carpospores, longueur diamètre	25 - 38 µm 20 - 33 µm	17.5 - 30 15 - 25	non précisées 20 - 25	22 - 42 16 - 29

Tableau 1. Caractéristiques des espèces de *Chondrus* à thalles aplatiss, subdichotomes et prolifères du Japon et de l'étang de Thau (* : d'après les illustrations de l'auteur).

Table 1. Characteristics of flat, subdichotomous and proliferous species of *Chondrus* from Japan and Thau lagoon (* : from illustrations given by the author)

hypothèse. L'origine de ces importations récentes, et donc illicites, d'huîtres asiatiques serait dans ce cas le Nord du Japon puisque, depuis sa description dans le détroit de Tsugaru (localité d'Omazaki), *Chondrus giganteus f. flabellatus* semble n'avoir été observé qu'au Nord-Ouest de l'île d'Honshu (Province d'Aomori) ainsi que dans la région d'Hakodate (île d'Hokkaido) (Mikami, 1965 ; Noda & Ohta, 1971 ; Noda, 1987 ; Brodie *et al.*, 1994). Dans l'ensemble de cette zone balayée par le *Tsushima warm current*, une branche du Kuroshio, la marée est faible (moins de 25 cm d'amplitude) et la température de l'eau oscille entre 14-20°C en février-mars et 28-29°C en août (Tokuda *et al.*, 1994). La flore algale de la région est considérée comme tempérée chaude (Ohta, 1973 ; Lüning *et al.*, 1986). Les derniers auteurs précisent que *C. giganteus f. flabellatus* survit à une température de 30°C. En conséquence, malgré des températures hivernales plus basses dans l'étang de Thau, l'acclimatation de cette algue sur notre littoral semble être bien engagée.

A présent et indépendamment de possibles nouvelles introductions directes d'Asie via les naissains d'huîtres, le risque d'une dissémination de ce *Chondrus* en Europe paraît élevé. En effet, dans le cadre de la législation européenne des transferts de coquillages, l'étang de Thau a été classé parmi les zones indemnes sur le plan

zoosanitaire ce qui signifie que les exportations vers d'autres sites conchylicoles de Méditerranée ou d'Atlantique sont libres. Ainsi, par exemple, des parcs atlantiques sont actuellement approvisionnés avec des huîtres plates (*Ostrea edulis* L.) captées dans l'étang. L'acclimatation d'un nouveau grand carraghénophyte en Europe pourrait paraître intéressante sur le plan économique, toutefois, il faut garder à l'esprit qu'il est impossible, à l'heure actuelle, de prévoir le comportement de l'algue sur nos côtes. A l'instar d'autres exemples récents, de telles espèces, une fois introduites, peuvent dans certains cas devenir très rapidement des nuisances incontrôlables (Ribera & Boudouresque, 1995).

La menace la plus importante se situe au niveau des stocks naturels de Carraghénophytes et notamment de ceux de l'espèce atlantique *Chondrus crispus* (risques de pollution génétique, de compétition, d'introduction de nouveaux parasites ou de nouvelles maladies, etc.). Exploités sur les deux rives de l'Atlantique Nord, les champs de *C. crispus* ont une grande importance sur le plan économique (plusieurs dizaines de milliers de tonnes récoltées annuellement). Or, malgré d'exceptionnelles capacités de tolérance vis-à-vis de certains paramètres environnementaux (température, salinité, profondeur), c'est dans une tranche bathymétrique assez étroite (entre +1 et -1m par rapport à la limite des plus basses mers) que *C. crispus* constitue ses peuplements les plus denses (cf. Pérez *et al.*, 1992). Par ailleurs, depuis 1975, tant aux USA qu'en Europe, les tonnages récoltés de *C. crispus* n'ont cessé de décroître en partie pour des raisons économiques (concurrence mondiale) mais apparemment aussi du fait de la raréfaction de la ressource (Pérez *et al.*, 1992). Dans ce contexte écologique et économique et compte-tenu du caractère imprévisible des conséquences d'une introduction, l'arrivée accidentelle du *Chondrus giganteus* f. *flabellatus* dans l'Atlantique n'est pas souhaitable. En conclusion, conjointement à une étude de valorisation de cette nouvelle ressource potentielle, un programme de surveillance de la population de *Chondrus* de l'étang de Thau devrait être instauré. Parallèlement, il serait prudent de mettre en place auprès des ostréiculteurs des mesures prophylactiques préventives efficaces afin de réduire les risques de dissémination de l'espèce au sein de la CEE.

REMERCIEMENTS — Nous tenons à remercier vivement M^{me} le Pr. F. Ardré pour sa très amicale participation à notre recherche bibliographique ainsi que MM. le Pr. Deslous-Paoli de l'IFREMER de Sète, le Dr. Zibrowius et M. Pichon pour leur soutien matériel et leur collaboration lors de nos campagnes de prélèvement.

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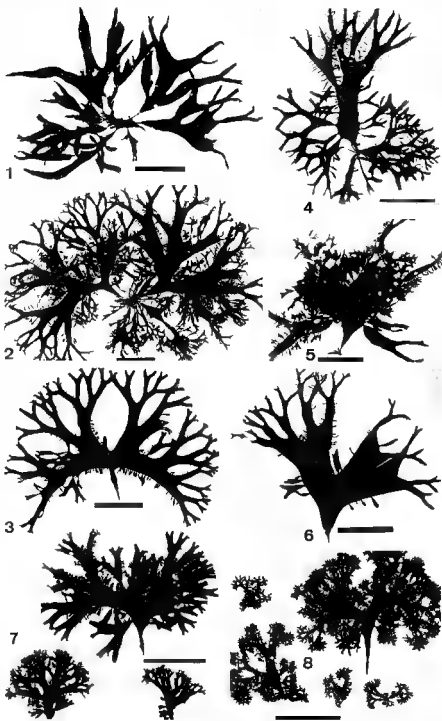
Figs 1-8. *Chondrus giganteus* Yendo f. *flabellatus* Mikami from Thau lagoon. Figs 1-6. Tetrasterophytes (specimens H.2550, H.2543, H.2546, H.2544, H.2553 and H.2560). Fig. 7. Spermatangial thalli (specimens H.2564 and 2565). Fig. 8. Female thalli (specimens H.2572 and H.2575). (Scale bars = 5 cm).

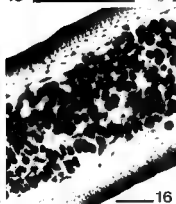
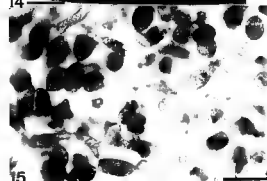
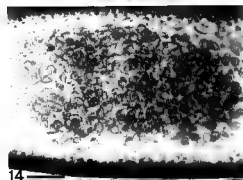
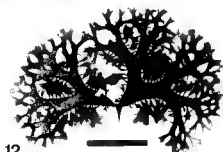
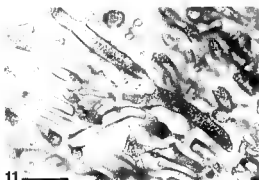
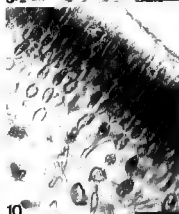
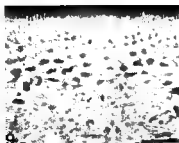
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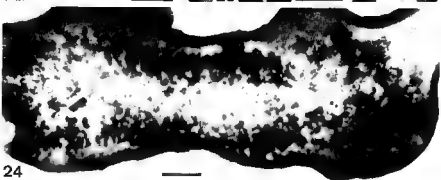
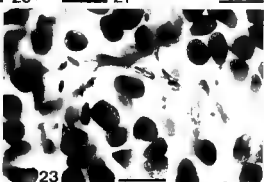
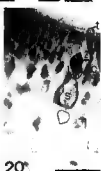
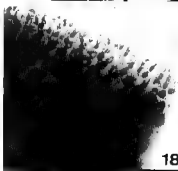
Figs 9-16. *Chondrus giganteus* Yendo f. *flabellatus* Mikami from Thau lagoon. Figs 9-11. Longitudinal sections of thallus (specimen H.2569). Fig. 9. Cortex and medulla. Fig. 10. Outer and inner cortex. Fig. 11. Medulla. Figs 12-13. Tetrasterophyte, habit and detail of sorus (specimen H. 2554). Figs 14-16. Longitudinal sections of tetrasporangial sorus (specimen H. 2553). Fig. 14. Young sorus. Fig. 15. Intercalary chains of young tetrasporangia. Fig. 16. Mature sorus. (Scale bars, figs 9, 14 and 16 = 100 µm; figs 10, 11 and 15 = 30 µm; figs 12 and 13 = 5 cm).

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Figs 17-24. *Chondrus giganteus* Yendo f. *flabellatus* Mikami from Thau lagoon. Figs 17-18. Spermatangial thallus (specimen H.2561). Fig. 17. Portion of thallus with marginal proliferations discoloured by spermatangial sori. Fig. 18. Longitudinal section of spermatangial sorus. Figs 19-24. Female thallus (H.2569). Fig. 19. Portion of thallus with cystocarps. Figs 20 and 21. Carpogonial branches (abbreviations : S, supporting cell ; 1, first carpogonial branch cell ; 2, second carpogonial branch cell ; C, carpogonium ; T, trichogyne ; fs, sterile branch). Fig. 22. Longitudinal section of young cystocarp. Fig. 23. Development of carposporangia. Fig. 24. Longitudinal section of mature cystocarp. (Scale bars, fig. 17 = 5 cm ; fig. 19 = 1 cm ; figs 18, 20, 21 and 23 = 30 µm ; figs 22 and 24 = 250 µm).







MORPHOLOGY AND ANATOMY OF *PAPENFUSSIELLA KUROMO* (CHORDARIACEAE, PHAEOPHYTA) FROM THE CANARY ISLANDS¹

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ABSTRACT — *Papenfussiella kuromo* (Yendo) Inagaki (Chordariaceae, Phaeophyta) is reported for the first time from the Atlantic, at Tenerife, Canary Islands. Until now, this species was known only from Japan and China. Macrothalli of *Papenfussiella kuromo* are characterized by an outer dense medulla where abundant rhizoidal branched filaments occur, short cortical filaments curved and clavate, up to 10 cells in length, long cortical filaments hair-like of cylindrical cells and rounded apices and a weakly-developed subcortex formed by successive branching at the base of cortical filaments. A well defined layer of unilocular sporangia are formed from the subcortical cells. An isoelectotype of *Myriocladia kuromo* Yendo as well as two specimens from Japan were compared with the Canary Islands plants.

RÉSUMÉ — *Papenfussiella kuromo* (Yendo) Inagaki (Chordariaceae, Phaeophyta), une espèce connue, jusqu'à présent, seulement du Japon et de Chine, est signalée pour la première fois sur les côtes atlantiques de Tenerife, aux îles Canaries. Les macrothalles de *Papenfussiella kuromo* sont anatomiquement caractérisés par des filaments médullaires externes compacts entre lesquels se développent de nombreux rhizoïdes ramifiés, des filaments corticaux courts, claviformes, arqués et dont la longueur peut atteindre 10 cellules, et des filaments corticaux longs, présentant l'aspect de poils et composés de cellules cylindriques ayant un sommet arrondi. Le caractère le plus remarquable est la formation d'une couche subcorticale, ce subcortex étant constitué par les divisions successives des cellules de la base des filaments corticaux. Les sporocystes uniloculaires naissent des cellules subcorticales et forment une couche bien définie. La morphologie et l'anatomie des spécimens des îles Canaries sont décrites et ces spécimens sont confrontés avec un isoelectotype de *Myriocladia kuromo* Yendo ainsi qu'avec deux échantillons additionnels en provenance du Japon.

KEY WORDS: Marine benthic algae, *Papenfussiella*, Chordariaceae, Phaeophyta, Canary Islands, new record.

1. This paper is part of an unpublished degree Thesis (Martín, 1995 — *Estudio de las especies de Chordariaceae y Spermatochnaceae (Chordariales, Phaeophyta) en las Islas Canarias*. Tesis de Licenciatura, Universidad de La Laguna).

INTRODUCTION

The Chordariales (Phaeophyta) is worldwide in distribution, except for the Antarctic (Papenfuss, 1964). Within the *Myriogloia*-group of the Chordariaceae, Kylin (1940) described *Papenfussiella* to include species differing from those of *Myriogloia* Kuckuck and *Levringia* Kylin principally in the production of numerous rhizoidal filaments at the base of cortical filaments that, once developed, could hardly be differentiated from the inner medullary filaments. These genera have also been placed within Myriogloeaceae by Christensen (1980, p. 138).

The aim of this paper is to describe *Papenfussiella kuromo* (Yendo) Inagaki from the Canary Islands, a species known previously only from Japan (Inagaki, 1958) and China (Tseng, 1983). This species was described as *Myriocladia kuromo* by Yendo (1920, p. 1) and transferred to *Papenfussiella* by Inagaki (1958, p. 128) because of the absence of phaeophycean hairs and the presence of long and short cortical filaments, the latter embedded in gelatinous substance.

MATERIALS AND METHODS

Data were obtained from: (1) plants collected in Playa San Marcos, North Tenerife, Canary Islands and deposited at TFC [Departamento de Biología Vegetal (Botánica), Universidad de La Laguna, Canary Islands] with the numbers 8877 (12.06.1994; J. Reyes, E. Muñoz, M. Sansón), 8878 (13.06.1994; J. Reyes, E. Muñoz, M. Sansón) and 8906 (12.04.1995; J. Reyes, M. Sansón); (2) an isoelectotype of *Myriocladia kuromo* deposited in SAP (Faculty of Science, Hokkaido University, Sapporo, Japan) with the number 060747 (12.03.1902; K. Yendo), collected at Sugashima, Japan; and (3) two specimens on the same herbarium sheet deposited at SAP with the number 058309 (30.03.1931; K. Inagaki), collected at Irigazaki, Japan. Morphological and anatomical observations were carried out on fragments fixed in 4% formalin in seawater. Selected small fragments of dried plants from the herbaria were rehydrated in 4% formalin in seawater and studied as slides prepared using 1% aniline blue. Drawings were obtained using a camera lucida attached to a Zeiss microscope. Micrographs were taken in a Zeiss photomicroscope.

RESULTS AND DISCUSSION

Specimens of *Papenfussiella kuromo* were collected at 4-5 m depth, growing on rocks settled on basaltic sandy bottom, together with other seasonal species of the genera *Acrosymphyton* Sjöstedt, *Dudresnaya* P. & H. Crouan, *Scinaia* Bivona-Bernardi and *Sporochinus* C. Agardh. Plants are erect, solid, subcartilaginous, slimy and cord-shaped (Fig. 1), up to 20 cm long, with a main axis to 4 mm in diameter arising from a small basal disc. Long lateral branches are irregularly arranged near the base of the main axis and produce a few short laterals. Numerous long cortical filaments cover the surface of branches, giving them a hairy appearance (Fig. 1).

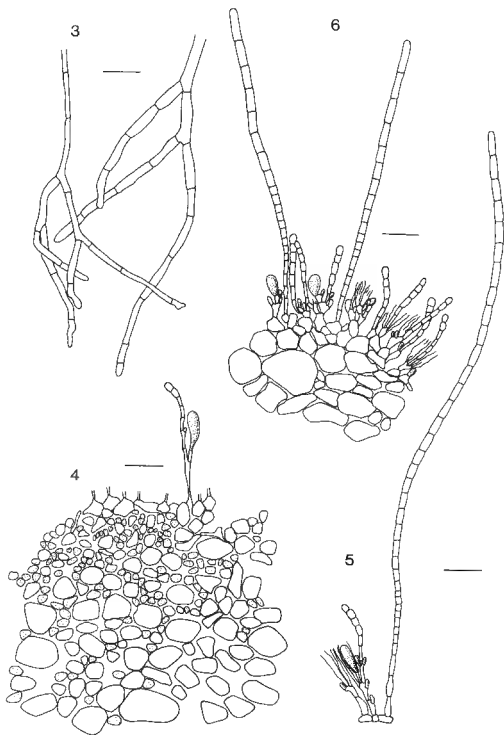
Anatomically, plants consist of an inner medulla, an outer medulla, a slight subcortex and a cortex. Inner medullary filaments are loosely arranged and are composed of ellipsoid to fusiform cells, 125-280 µm long and (37) 45-65 µm in dia-



Figs 1-2. *Papenfussiella kuromo* (Yendo) Inagaki. TFC 8877. Fig. 1. Habit. (Scale = 4 cm). Fig. 2. Transverse section of a branch, showing dense outer medullary cells. Note the continuous layer consisting of curved short cortical filaments and unilocular sporangia. (Scale = 50 μ m).

meter, with smaller cells distally. Outer medullary filaments form a dense layer (Fig. 2), with ellipsoid to ovoid cells, 20-30 μ m long and 17-23 μ m in diameter. Branched rhizoidal filaments (Fig. 3) are abundant and intermingled with outer medullary filaments (Fig. 4). Rhizoidal filaments are borne at the base of cortical filaments, subcortical cells or, occasionally, outer medullary cells. Subcortical filaments consist of 1-3 clavate cells, bearing short cortical filaments distally (Figs 5-6). Two kinds of cortical filaments are present. Long cortical filaments are hair-like, to 2.5 mm long with up to 55 cells, cylindrical, with a division zone near their base (Fig. 5). Short cortical filaments are simple, curved, club-shaped, 60-120 μ m long, composed of 5-8 cells, and densely cover the surface of branches (Fig. 5). Proximal cells of these filaments are cylindrical, (10) 17-25 μ m long and up to 5 μ m in diameter; the distal ones are ovoid to subspherical, to 15 μ m long and 8 μ m in diameter. Unilocular sporangia, ovoid to pyriform, (35) 42-68 μ m long and 10-25 μ m in diameter, are abundant and formed singly or in pairs from the distal ends of subcortical cells (Figs 2, 6).

Examination of an isoelectotype of *Myriocladia kuromo* (SAP 060747) has allowed us to confirm the identity of the Canarian plants. The isoelectotype specimen



(Fig. 7) is 23 cm long, with a small basal disc from which arise a main axis, 2 mm in diameter, with numerous primary branches, 1.5-2 mm in diameter, arranged irregularly alternately bearing few secondary short branches. The plant is abundantly covered with long cortical filaments on the entire surface of the branches. The dimensions and morphology of cells are similar to the material from the Canary Islands plants. Only a few empty sheaths of sporangia were detected.

Two other specimens from Japan (SAP 058309) have also been studied (Fig. 8). One is 29 cm long, with a small basal disc from which two main axes arise, the longest one 3.5 mm in diameter with several short branches, from 250 μ m to 1 mm broad. No sporangium was observed. The other is 27.5 cm long, with a small basal disc and consist of five main axes, 1-3 mm in diameter. Two axes have abundant lateral branches to 1.5 mm in diameter, the rest have only a few short branches. This plant bears numerous ovoid to pyriform unilocular sporangia borne on subcortical cells.

Papenfussiella includes seven species: *P. callitricha* (Rosenvinge) Kylin, *P. extensa* Womersley et Bailey, *P. gracilis* Kylin, *P. kuromo* (Yendo) Inagaki, *P. laxa* Kylin, *P. lutea* Kylin and *P. tristanensis* Kylin (Kylin, 1940; Womersley, 1987). These species (Table 1) are mainly segregated by habit, morphology, and cellular dimensions of long and/or short cortical filaments. Specimens from the Canary Islands are in good agreement with *Papenfussiella kuromo* (Inagaki, 1958) and the Japanese specimens examined. Inagaki (1958) pointed out the absence of a subcortical layer in this species, although according to his drawings (Inagaki, 1958, p. 132, Fig. 38 D-F, Fig. 39 A) there was a slight subcortex of 1-3 clavate hyaline cells at the base of short cortical filaments from which unilocular sporangia are laterally arranged. This also has been observed in specimens studied from Japan and the Canary Islands (Fig. 5). This feature separates *Papenfussiella kuromo* from the rest of the species.

P. kuromo also differs from other Atlantic species in morphology and cellular dimensions of long cortical filaments (Table 1), being in this species cylindrical and with cells to 7 times as long as broad, 4.5-6 μ m in diameter. *P. gracilis*, reported from western South Africa, has long cortical filaments with cells being suddenly broader, up to 15-20 μ m in diameter, above the meristem (Kylin, 1940). *P. laxa*, also known from Western South Africa (Kylin, 1940), has long cortical filaments being progressively broader in the middle and then narrower towards the apices, with cells to 1.5 times as long as broad, showing slight constrictions between two successive cells. *P. tristanensis* is poorly known and has only been reported from the type locality, Seal Bay at Tristan da Cunha (Kylin, 1940), showing long cortical filaments with cells 1-1.5 times as long as broad, 10-15 μ m in diameter. In *P. callitricha* the long cortical filaments are similar to those of *P. kuromo* but it has a subarctic distribution and the macrothallus do not grow at temperatures higher than 8°C (Hooper & South, 1977; Peters, 1984).

Figs 3-6. *Papenfussiella kuromo* (Yendo) Inagaki. TFC 8877. Fig. 3. Branched rhizoidal filaments. (Scale = 50 μ m). Fig. 4. Detail of a transverse section of a branch, showing the arrangement of rhizoidal filaments (pointed cells) between outer medullary cells. (Scale = 50 μ m). Fig. 5. Detail of a long cortical filament and a short one with unilocular sporangia arising from distal ends of subcortical cells. Note the presence of some empty sheaths of sporangia. (Scale = 50 μ m). Fig. 6. Detail of a transverse section of a branch, showing long and short cortical filaments and several unilocular sporangia arising from subcortical cells. (Scale = 50 μ m).

CHARACTERS	<i>P. KUROMO</i> this study	<i>P. KUROMO</i> Inagaki, 1958	<i>P. LUTEA</i> Kylin, 1940	<i>P. LUTEA</i> Womersley, 1987	<i>P. EXTENSA</i> Womersley, 1987
Medullary cells					
Diameter	(37)-45-63	-	-	10-16-(20)	10-22
L/D	2-4-(7)	-	-	(4)-6-12-(15)	2-4-(6)
Short cortical filaments					
Morphology	very curved	very curved	very curved	right or slight. curved	slight. curved
Length	60-120	50-100	100-150	100-250	30-60
Number of cells	5-8	6-10	8-12	10-20	(4)-6-12
Diameter basal cells	5	-	-	< apical cells	< apical cells
Diameter apical cells	8	-	8-10	(6)-8-10	4-6
Long cortical filaments					
Morphology	cylindrical	cylindrical	cylindrical	tortuose above meristems	cylindrical
Length (mm)	2-2.5	1-2	1-1.5	1-1.5	1-2.5
Number of cells	up to 55	-	-	up to 50	up to 50
Diameter basal cells	4.5-6	-	10-15	< apical cells	(7)-8-10
L/D basal cells	3-5	-	1-2	-	1-1.5
Diameter apical cells	(7)-10-13	-	6-8	15-20	-
L/D apical cells	4.5-7-(8.5)	-	3-4	1.5-2	3-4
Unilocular sporangia					
Origin	subcortical cells	subcortical cells or base of cortical filaments	(*) outer medullary cells or base of cortical filaments	outer medullary cells or rhizoidal cells	outer medullary cells or base of cortical filaments
Length	(35)-42-68	20-40	55-65	(40)-45-70-(95)	(30)-40-50
Diameter	10-25	20-40	30-35	15-30	16-24

Table 1. Comparison of characters in *Papenfussiella* species. (*) = Data obtained from drawings. All measurements in μm . L/D = length/diameter ratio.

P. lutea and *P. extensa* have been reported from New Zealand, Tasmania and southern Australia (Kylin, 1940; Womersley, 1987). *P. lutea* differs from *P. kuromo* in the origin of unilocular sporangia, arising directly from outer medullary filaments or from rhizoidal filaments in *P. lutea* (Womersley, 1987), whereas in *P. kuromo* they borne on subcortical cells. Finally, *P. extensa* has shorter and thinner short cortical filaments as well as thinner long ones, than any other species of the genus (Womersley, 1987).

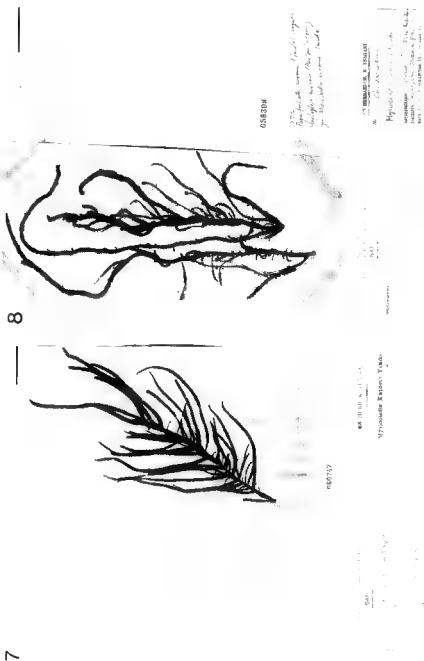
Until now, *Papenfussiella kuromo* was known only from Japan and China (Zhejiang Province; Tseng, 1983). The presence of *Papenfussiella kuromo* at the Canary Islands seems quite surprising. According to Womersley (1987, p. 109), species of *Papenfussiella* are separated mainly on robustness and cell diameters and proportions in the long cortical filaments, and this is not clear cut between some of the species which are poorly-known. In this sense, the geographical distribution of some species of *Papenfussiella* may be much wider than actually known. We think that this species has not been newly introduced in the Canary Islands but rather has not been collected up to now, due to (1) the short seasonal occurrence of the macrothallus, (2) the unstable

CHARACTERS	<i>P. CALLITRICHA</i> Kylin, 1940	<i>P. CALLITRICHA</i> Wilce, 1969	<i>P. GRACILIS</i> Kylin, 1940	<i>P. LAXA</i> Kylin, 1940	<i>P. TRISTANENSIS</i> Kylin, 1940
Medullary cells					
Diameter	-	15-33	-	-	-
L/D	-	-	-	-	-
Short cortical filaments					
Morphology	-	-	-	-	-
Length	-	up to 80	-	-	-
Number of cells	-	-	-	-	-
Diameter basal cells	-	7-11	-	-	-
Diameter apical cells	-	10-16	-	-	-
Long cortical filaments					
Morphology	cylindrical	-	suddenly broader above meristem	progressively broader above meristem	slightly broader above meristem
Length (mm)	1.5-2.5	-	1-2	1-1.5	1-1.5
Number of cells	-	-	-	-	-
Diameter basal cells	-	-	15-20	25-30	10-15
L/D basal cells	1-2	-	0.5-1	0.5-1	1-1.5
Diameter apical cells	-	-	8	12-15	6-8
L/D apical cells	3-5	-	1-1.5	1-1.5	2-2.5
Unilocular sporangia					
Origin	-	base of cortical filaments	(*) base of cortical filaments	(*) outer medullary cells or base of cortical filaments	-
Length	-	52-71	90-110	110-130	70-90
Diameter	-	19-30	30-40	35-45	25-35

Table 1 (continuation). Comparison of characters in *Papenfussiella* species. (*) = Data obtained from drawings. All measurements in μm . L/D = length/diameter ratio.

habitat where this species grows (on scattered rocks established on sandy bottoms), and (3) the small number of individuals forming populations of the species. Furthermore, *Papenfussiella* grows far away from harbours which are the main points of introduction of species.

ACKNOWLEDGEMENTS — We wish to express our gratitude to Prof. Dr T. Yoshida (Hokkaido University, Japan) for the loan of specimens from SAP, and to three anonymous referees for their suggestions, one of them significantly improved both English and style. Thanks also are due to Dr J. Afonso-Carrillo for his comments and to E. Muñoz for his help in field collections.



Figs 7-8. Fig. 7. Isolectotype of *Myriocladia kuromo* Yendo. SAP 060747. (Scale = 5 cm).
 Fig. 8. *Papenfussiella kuromo* (Yendo) Inagaki. SAP 058309. (Scale = 5 cm).

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THE DIATOM TYPES OF EMILE MANGUIN. I. VALIDATING DESCRIPTIONS AND DESIGNATION OF ICONOTYPES FOR THE LAKE KARLUK SPECIES.

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ABSTRACT — The 51 taxa described as new by Emile Manguin in his 1961 paper on diatoms from Lake Karluk, Alaska (USA), lacked Latin descriptions and type designations; they are therefore invalid according to the International Code of Botanical Nomenclature. We provide Latin descriptions for Manguin's taxa and, due to our inability to find original slides or material in Manguin's collection, we designate holotypes from Manguin's original work. English translations of the original French descriptions are also provided.

RÉSUMÉ — Dans son article de 1961 sur les diatomées du lac Karluk, Alaska (USA), Emile Manguin a décrit 51 nouveaux taxons, mais sans accompagner ses descriptions de diagnoses latines et sans désigner de type; ils sont donc invalides selon le code international de nomenclature botanique. Nous fournissons une diagnose latine pour chacun des taxons de Manguin. N'ayant pu trouver les préparations ou les récoltes originales de cet auteur, nous avons désigné les illustrations de son article comme iconotypes. Des traductions en anglais des descriptions originales en français sont aussi fournies.

KEY WORDS: Bacillariophyceae, diatom, taxonomy, nomenclature, type, Alaska, Manguin.

INTRODUCTION

Emile Manguin published numerous works between 1933 and 1964 on diatoms from localities around the world (see Bourrelly 1967a, b for summaries of most, but not all, of Manguin's papers). His works covered fossil and recent localities, marine and freshwater habitats and a broad spectrum of diatom taxa. Manguin's collection resides in the Laboratoire de Cryptogamie, Muséum National d'Histoire Naturelle, Paris (PC). Manguin rarely identified type specimens on his slides, or the slides as types, and in some cases none of the original slides can be found; only material is extant.

In his contribution on the diatoms of Lake Karluk, Alaska, Manguin (1961)

proposed 51 taxa as new. He did not meet the requirements for valid publication, however, because he omitted Latin descriptions and did not designate types for his new taxa (International Code of Botanical Nomenclature, Articles 32.1, 36, 37; Greuter *et al.* 1994). We have been unable to find slides or material from Lake Karluk in the Manguin collection at PC. Therefore, in this first contribution on the diatom types of Manguin, we offer validating descriptions and typification of his taxa by designating his original illustrations as holotypes for the species as provided for in Article 8.3 of the ICBN (Greuter *et al.* 1994). Since Manguin's taxa were not validly published, they must be treated as new and originating in this publication.

Pagination under each new taxon name indicates the page in Manguin (1961) on which his description appears. Holotype designation is the plate and figure number in Manguin's work. English translations of the original French descriptions are also provided. Figure explanations for plates 5 and 6 were reversed in Manguin's publication. We recognize the plate order as it is presented in the body of the manuscript, not the order of the figure explanations.

NEW TAXA, DESCRIPTIONS AND TYPE DESIGNATIONS

Cyclotella bodanica Eulenstein in Grunow var. *intermedia* Manguin ex Kociolek & Reviere

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Holotype: Pl. 1, fig. 1

Descriptio: Diameter 23 μm . *Zona marginalis striis subtiliter lineatis 11/10 μm , punctis sejunctis 2-3/10 μm . Zona intermedia tecta seriebus irregularibus punctorum. Zona centralis tecta punctis sparsis.*

Description: Diameter 23 μm , marginal zone with 11 striae/ 10 μm finely lineate, 2-3 isolated puncta ('flamettes') in 10 μm . Intermediate zone covered by irregular rows of puncta. Central zone covered with sparse puncta.

Cyclotella lacus-karluki Manguin ex Kociolek & Reviere

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Holotype: pl. 1, fig. 6

Descriptio: Forma perpusilla. Diameter 3-3.5. *Striae circa 13/10 μm . Spinae parvae 4-5 prope marginem valvarum. Zona centralis punctis 2-3 circumcinctis corona umbrosa, seperata striis spatio magno hyalino.*

Description: Very small form, diameter 3-3.5 μm , about 13 striae/10 μm , 4-5 minute spines placed near the edge of the valve. Central zone as 2-3 puncta surrounded by the hint of a shadow, separated from the striae by a large hyaline space.

***Fragilaria capucina* Desmazières var. *sublinearis* Manguin ex Kociolek & Reviere**

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Holotype: p. 1, fig. 7

Description: Valvae linearis lateribus parallelis. Longitudo 39 μm . Latitudo 13 μm . Striae 16/10 μm . Pseudoraphe lanceolata. Area centralis relative elata marginata striis marginali brevissimis et vix visibilibus.

Description: Valves linear with parallel sides, length 39 μm , breadth 3 μm ; 16 striae/10 μm . Pseudoraphe lanceolate, central area relatively high and bordered by very short and barely visible marginal striae.

***Fragilaria pseudocylindrus* Manguin ex Kociolek & Reviere**

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Holotype: pl. 1, fig. 9

Description: Frustula connexa in filis rectangulatis. Valvae linearis constrictae leviter prope polos late rotundato. Longitudo 26 μm . Latitudo 2.5 μm . Striae circa 14/10 μm , perpendiculares lineae medianae. Pseudoraphe perangusta autem manifesta.

Description: Frustules connected in rectangular bands. Valves linear, lightly constricted near the broadly rounded poles, length 26 μm , breadth 2.5 μm , about 14 striae/10 μm , perpendicular to the median line. Pseudoraphe very narrow but apparent.

***Fragilaria vaucheriae* (Kützing) Petersen var. *elliptica* Manguin ex Kociolek & Reviere**

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Holotype: pl. 1, fig. 10

Description: Valvae late ellipticae-lanceolatae, ad extremitibus leniter contractae, ad polos late rotundatae. Longitudo 9.5 μm . Latitudo 4.5 μm . Striae 12-13/10 μm . Area centralis unilateralis peraperta. Pseudoraphe distincte lata versus area laterali.

Description: Valves very widely elliptical-lanceolate, weakly contracted at the extremities, broadly rounded at poles, length 9.5 μm , breadth 4.5 μm , 12-13 striae/10 μm . Unilateral central area very open. Pseudoraphe notably widens towards lateral area.

***Achnanthes bernierii* Manguin ex Kociolek & Reviere**

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Holotype: pl. 1, fig. 18, 19

Description: Valvae lanceolatae plus minusve ad extremitibus contractae-rostratae, polis rotundatis-obtusis. Longitudo 22 μm . Latitudo 4.5 μm . Valva sine raphe striis radialibus circa 10-13/10 μm , pseudoraphe angusta ad extremitibus deminuta. Valva raphe striis numeri pro valva opposita, radialibus, striis medianis abbreviatis, lineis longitudinalibus hyaline subtilibus undulatis cruciatim. Area axialis perangusta. Raphe recta filiformis.

Description: Valves lanceolate more or less constricted to subrostrate at the extremities, poles rounded-obtuse, length 22 μm , breadth 8 μm . Valves without raphe have radiate

striae about 10-13/10 μm ; pseudoraphe narrow, shrinking towards the extremities. Raphe valve with striae of like number as the opposing valve, also radial, the median striae shortened, crossed by the delicate undulate hyaline longitudinal lines. Axial area linear very narrow. Raphe straight filiform.

***Achnanthes hilliardii* Manguin ex Kociolek & Reviere**

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Holotype: pl. 1, fig. 24-26

Description: Valvae ellipticae. Longitudo 14 μm . Latitudo 4.5 μm . Striae radiatae et similes in ambo valvis, 16-18/10 μm . Puncta visa difficulter.

Description: Valves elliptical, length 14 μm , breadth 4.5 μm . Striae radial and similar in number on the two valves, 16-18/10 μm . Puncta difficult to resolve.

***Achnanthes lucus-karluki* Manguin ex Kociolek & Reviere**

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Holotype: pl. 1, fig. 27, 28

Description: Valvae ellipticae-lanceolatae. Longitudo 17 μm . Latitudo 8 μm . Striae in ambo valvis 16-18/10 μm . Valvae sine raphibus area axilla plus minusve perangusta. Area centralis unilateralis rectangularis, margini valva expansa, nota marginali semicirculari. Valva raphe area axiali angusta lineari. Raphe filiformis poris centralibus manifeste obvis.

Description: Valves elliptical lanceolate, length 17 μm , breadth 8 μm ; striae on the two valves about 16-18/10 μm . Valves without raphe have an axial more or less linear and very narrow. Central area unilaterally rectangular extending up to the border of the valve, provided with a marginal mark of a semicircle. Valve with raphe with a narrow linear axial area; raphe filiform with central pores easy to see.

***Achnanthes oblonga* Manguin ex Kociolek & Reviere**

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Holotype: pl. 1, fig. 35, 36

Description: Valvae ellipticae-lanceolatae, extremitibus late rotundatis. Longitudo 17 μm . Latitudo 5 μm . Striae radiales circa 23/10 μm in ambo valvis. Valva sine raphe pseudoraphe lineari stricta, area centrali dilatata unilaterilibus ad marginem valvae. Striae mediae duae oppositae aream centalem dilute abbreviatae et dispositae ultra vicinis strias. Valva raphe area axiali lineari recta. Area centralis circularis parvula.

Description: Valves elliptical-lanceolate, broadly rounded at the extremities, length 17 μm , breadth 5.5 μm , about 23 radial striae in 10 μm on both valves. Valve without raphe possesses a linear pseudoraphe that is very straight, central area unilaterally enlarged to the edge of the valve, the 2 median striae opposite are slightly more short and more spaced than their neighbors. Raphe valve with a linear, straight axial area, circular central area very small.

***Achnanthes pseudosuchlandtii* Manguin ex Kociolek & Reviere**

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Holotype: pl. 1, fig. 37, 38

Descriptio: *Valvae lateribus fere parallelis sed dilute convexis ad partem medianam, ad extremitibus contractis abrupte et rostratis ad subcapitatis, polis late rotundatis. Longitudo 8 µm. Latitudo 3.5-4 µm. Valva sine raphe striis radialibus 26-28/10 µm. Striae peragratæ sulco longitudinali hyalino. Pseudoraphe linearis perangusta. Valva raphe striis radiali 25-26/10 µm, area axiali lanceolata, raphe filiformi.*

Description: Valves with nearly parallel sides but very slightly convex about the median part, abruptly contracted and rostrate to subcapitate at the extremities with poles broadly rounded, length 8 µm, breadth 3.5-4 µm. Valve without raphe has radial striae, 26-28/10 µm, crossed by a hyaline longitudinal groove, pseudoraphe linear, very narrow. Valve with raphe has radial striae 25-26/10 µm, axial area lanceolate, raphe filiform.

***Diploneis voigtii* Manguin ex Kociolek & Reviere**

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Holotype: pl. 2, fig. 1

Descriptio: *Valvae ellipticae lute. Longitudo 30 µm. Latitudo 14 µm. Nodulus centralis subquadratus. Cornua perdistincta et parallela. Sulcus raphis dilute profundus. Canalis longitudinalis angustatus et dilute amplificatus circum nodulo centrali, extremitibus convergens. Costae transapicales robustae radiales 9-10/10 µm, peragratæ lineis 3 longitudinalibus incurvatis, linea intermedia minus notata et ad extremitibus non extensis. Linea subtilis umbrosa visibilis inter lineis longitudinalibus. Canalis longitudinalis peragratæ costis transapicalibus, sine seriebus pori.*

Description: Valves widely elliptical, length 30 µm, breadth 14 µm. Central nodule with a subquadrate shape; horns very distinct and slightly larger around the central nodule, becoming convergent towards the extremities. Transapical ribs robust, radial, 9-10/10 µm, crossed by 3 incurved longitudinal bands, the less marked intermediate band does not extend to the extremities of the valve, between these bands a delicate shadow line is visible. Longitudinal canal crossed by the transapical ribs, without rows of pores.

***Navicula amoena* Manguin ex Kociolek & Reviere**

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Holotype: pl. 1, fig. 39

Descriptio: *Valvae ellipticae ad circulares. Longitudo 10.5 µm. Latitudo 7.5 µm. Area axialis perangusta versus nodulum centrale dilute latum factum. Raphe filiformis prope porum centrum leviter manifesta. Striae valde radiales 23-26/10 µm ad partem medianam, 30 et plus/10 µm ad extremitatum. Striae medianae abbreviatæ irregulariter.*

Description: Valves elliptical to subcircular, length 10.5 µm, breadth 7.5 µm. Axial area very narrow, weakly broadening towards the central nodule. Raphe filiform slightly more apparent near the central pores. Striae strongly radial, 23-26/10 µm at the median part, 30 and more/10 µm at the extremities, the median striae irregularly shortened.

***Navicula bourrellyi* Manguin ex Kociolek & Revers**

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Holotype: pl. 1, fig. 40

Descriptio: *Valvae marginem medium dilute convexae, ad extremitatum contractae tum capitatae. Longitudo 15-16 µm. Latitudo 6.5 µm. Area axialis perangusta. Area centralis amplificata transverse. Striae radiales 19-23/10 µm.*

Description: Valves weakly convex at the median margin, contracted then capitate at the extremities, length 15-16 µm, breadth 6.5 µm. Axial area very narrow, central area enlarged transversely. Radial striae 19-23/10 µm.

***Navicula clementis* Grunow var. *quadristigmata* Manguin ex Kociolek & Revers**

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Holotype: pl. 2, fig. 2

Descriptio: *Valvae late ellipticae-lanceolatae, ad extremitatum subrostratae. Longitudo 22 µm. Latitudo 9 µm. Striae radiales 12-13/10 µm. Striae medianae curvae et abbreviatae alternatim. 2 stigmata in quoque latere noduli centralis.*

Description: Valves broadly elliptical-lanceolate, subrostrate at the extremities, length 22 µm, breadth 9 µm. Radial striae 12-13/10 µm. The median striae curved and alternately shortened. Two stigmata points on each side of the central nodule.

***Navicula disjunctoides* Manguin ex Kociolek & Revers**

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Holotype: pl. 2, fig. 3

Descriptio: *Valvae anguste ellipticae-lanceolatae, late rostratae-subcapitatae ad polis. Longitudo 21.5 µm. Latitudo 4.5 µm. Area axialis angusta linearis, area centralis rectangularis. Striae radiales 12-13/10 µm, perpendiculares lineae medianae ad extremitatum.*

Description: Valves narrowly elliptical-lanceolate, broadly rostrate-subcapitate at the extremities, length 21.5 µm, breadth 4.5 µm. Axial area narrow linear; central area rectangular. Striae radial 12-13/10 µm, the terminal ones perpendicular to the median line. This species is differentiated from *N. disjuncta* Hust. by the perpendicular direction of the terminal striae and the less dense general striation.

***Navicula exigua* (Gregory) Grunow in Van Heurck var. *alaskensis* Manguin ex Kociolek & Revers**

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Holotype: pl. 2, fig. 4

Descriptio: *Valvae late ellipticae-lanceolatae, ad extremitatum dilute angustatae polis rotundatis-obtusis. Longitudo 15-16 µm. Latitudo 7 µm. Striae radiales 15/10 µm. Striae medianae alternatim longae et breves.*

Description: Valves broadly elliptical-lanceolate, weakly narrowed at the extremities, poles rounded-obtuse, length 15-16 µm, breadth 7 µm, 15 radial striae in 10 µm, the median ones alternately long and short.

***Navicula fossilioides* Manguin ex Kociolek & Reviere**

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Holotype: pl. 2, fig. 5

Description: *Valvae lanceolatae ad extremitatum rotundatae-obtusae. Longitudo 11-15 µm. Latitudo 3-4 µm. Area axialis lanceolata 1/5-1/3 latitudinis valvae in parte mediana. Striae radiales circa 13-15/10 µm.*

Description: Valves lanceolate rounded-obtuse at the extremities, length 11-15 µm, breadth 3-4 µm. Axial area lanceolate, 1/5 to 1/3 of the length of the valve in the median part. Radial striae about 13-15/10 µm.

Comments: Two figures of this taxon were presented by Manguin (pl. 2, figs 5 and 6), but they differed significantly from each other, particularly with respect to striae length and density. We have chosen figure 5 as the holotype since it most closely fits the short description provided by Manguin.

***Navicula hilliardii* Manguin ex Kociolek & Reviere**

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Holotype: pl. 2, fig. 7

Description: *Valvae lineares-ellipticae polis rotundatis. Longitudo 32 µm. Latitudo 8 µm. Area axialis versus nodulum centralem amplificata manifeste, faciens ellipticam aream centralem. Raphe recta polis centralibus aliquantum distantibus inter se. Striae radiales punctatae circa 18/10 µm ad extremitatum plus dense.*

Description: Valves linear-elliptical with poles broadly rounded, length 32 µm, breadth 8 µm. Linear axial area noticeably enlarged in the direction of the central nodule, becoming an elliptical central area. Raphe straight with central pores fairly distant from each other. Radial striae punctate about 18/10 µm, more compact towards the extremities.

***Navicula illicita* Manguin ex Kociolek & Reviere**

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Holotype: pl. 1, fig. 43

Description: *Valvae ellipticae. Longitudo 8 µm. Latitudo 3-3.5 µm. Area axialis elliptica occupans grandem partem valvae. Raphe vix visibilis prope nodulum centralem, non nisi lineam umbrorum alibi. Striae marginales brevissimae radiales 20/10 µm.*

Description: Valves elliptical, length 8 µm, breadth 3-3.5 µm. Axial area elliptical occupying a large expanse of the valve. Raphe hardly visible near the central nodule, indicated only by a shaded line the rest of the route. Marginal striae very short, radial, 20/10 µm.

***Navicula insolita* Manguin ex Kociolek & Reviere**

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Holotype: pl. 2, fig. 8

Description: *Valvae lineares-ellipticae polis late rotundatis. Longitudo 26-34 µm. Latitudo 8-9.5 µm. Area axialis linearis ad extremitatum aperata area polari circulari. Area*

centralis elliptica. Sulcus internus raphis dilute amplificatus circum nodulum centalem et ad polos. Rami raphis prope nodulum polarem costa parva ad modum manifesta interrupti. Striae radiales 15-20/10 μ m ad extremitatum 23-26/10 μ m, 2-3 in quoque latere area centrali plus abbreviatae.

Description: Valves linear-elliptical, poles broadly rounded, length 26-34 μ m, breadth 8-9.5 μ m. Axial area linear broad, open at the extremities only a circular polar area, central area elliptical. Raphe running in the interior of the furrow, somewhat slightly enlarged around the central nodule and towards the poles; branches of the raphe interrupted at the polar nodules by a small rib that is quite apparent. Striae radial, 15-20/10 μ m, 23-26/10 μ m at the extremities, 2-3 striae more shortened on each side of the central area.

Navicula lacus-karluki Manguin ex Kociolek & Reviere

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Holotype: pl. 2, fig. 10

Description: *Valvae lanceolatae ad extremitatum attenuatae, ad polos rotundatos obtusos. Longitudo 21 μ m. Latitudo 5.5 μ m. Area axialis lanceolata anguste, Area centralis subcircularis. Raphe poris manifestis. Striae valde radiales, ad extremitatum convergentes, 9/10 μ m. Striae terminales cristis marginalibus destitutae.*

Description: Valves lanceolate, attenuate at the extremities, rounded obtuse at the poles, length 21 μ m, breadth 5.5 μ m. Axial area narrow, lanceolate, central area subcircular. Raphe with pores apparent. Radial striae robust, convergent at the extremities, 9/10 μ m, the terminal striae without ridges only their sides.

Navicula minimoides Manguin ex Kociolek & Reviere

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Holotype: pl. 1, fig. 44

Description: *Valvae ellipticae. Longitudo 12.5 μ m. Latitudo 6.5 μ m. Area axialis angusta linearis. Area centralis elliptica. Raphe poris centralibus manifestis et inter se accedentibus. Striae radiales 13/10 μ m, ad extremitatum plus densae.*

Description: Valves elliptical, length 12.5 μ m, breadth 6.5 μ m. Axial area narrow, linear, central area elliptical. Raphe with central pores obviously apparent and approaching each other. Radial striae 13/10 μ m, very condensed at the extremities.

Navicula opiei Manguin ex Kociolek & Reviere

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Holotype: pl. 2, fig. 12

Description: *Valvae lineares lateribus parallelis et polis late rotundatis. Longitudo 13-19 μ m. Latitudo 5-6 μ m. Area axialis linearis circum nodulum centalem vix amplificata. Raphe poris centralibus manifestis. Striae radiales 23-26/10 μ m linea longitudinali hyalina prope aream centalem peragratae.*

Description: Valves linear, sides parallel, broadly rounded at the poles, length 13-19 μ m, breadth 5-6 μ m. Axial area linear hardly enlarged around the central nodule. Raphe with central pores well apparent. Radial striae 23-26/10 μ m, crossed by a hyaline longitudinal line near the axial area.

***Navicula perfida* Manguin ex Kociolek & Reviere**

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Holotype: pl. 2, fig. 13

Description: Valvae ellipticae. Longitudo 9.5 μm . Latitudo 5 μm . Area axialis linearis angusta. Area centralis expansa irregulariter. Raphe filiformis. Striae perpendiculares lineae medianae, 19/10 μm ad partem medianam 23/10 μm ad extremitatum.

Description: Valves elliptical, length 9.5 μm , breadth 5 μm . Axial area linear, narrow. Central area irregularly expanded. Raphe filiform. Striae perpendicular to the median line, 19/10 μm at the median part, 23/10 μm towards the extremities.

***Navicula pseudohasta* Manguin ex Kociolek & Reviere**

Page 276

Holotype: pl. 2, fig. 14

Description: Valvae ellipticae-lanceolatae elongatae ad extremitatum, ad polis rotundatis-angustis. Longitudo 34-37 μm . Latitudo 8-9 μm . Area axialis lanceolata perangusta. Area centralis circularis. Raphe versus poros centrales plus notatae. Striae radiales 10/10 μm subtiliter lineatae.

Description: Valves elliptical-lanceolate, elongated to the extremities, rounded to subacute at the poles, length 34-47 μm , breadth 8-9 μm . Axial area lanceolate, very narrow; central area circular. Raphe more emphasized towards the central pores. Radial striae 10/10 μm , finely lineate.

***Navicula semidiversa* Manguin ex Kociolek & Reviere**

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Holotype: pl. 2, fig. 17

Description: Valvae ellipticae-lanceolatae ad extremitatum subrostratae ad polis late rotundatis. Longitudo 15.5 μm . Latitudo 5.5 μm . Area axialis linearis. Area centralis rectangularata. Striae radiales 23-27/10 μm , abrupte parallel ad extremitatum. Striae medianae alternatim abbreviatae.

Description: Valves elliptical-lanceolate, subrostrate at the extremities, broadly rounded at the poles, length 15.5 μm , breadth 5.5 μm . Axial area linear, central area rectangular. Radial striae pass abruptly in direction to parallel at the extremities, the median striae alternately shortened, 23-27/10 μm

***Navicula verecundoides* Manguin ex Kociolek & Reviere**

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Holotype: pl. 2, fig. 18

Description: Valvae ellipticae-lanceolatae, ad extremitatum decrescentes subrostratae ad polis late rotundatis. Longitudo 13.5 μm . Latitudo 5.5 μm . Area axialis perangusta dilute lanceolata. Area centralis late rectangularis. Striae radiales 26/10 μm ad extremitatum 28-30/10 μm . Striae medianae abbreviata ordinatae.

Description: Valves elliptical-lanceolate, tapering, subrostrate at the extremities, largely rounded at the poles, length 13.5 μm , breadth 5.5 μm . Axial area very narrow, weakly

lanceolate; central area broadly rectangular. Radial striae 26/10 μm , 28-30/10 μm at the extremities. Median striae regularly shortened.

***Caloneis bacillaris* (Gregory) Cleve var. *rectangularis* Manguin ex Kociolek & Reviere**

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Holotype: pl. 2, fig. 19

Description: *Valvae lineares, ad polis late rotundatis. Longitudo 13 μm . Latitudo 4.5 μm . Area axialis angusta linearis. Striae ad lineam medianum perpendiculares, ad extremum radiales 23-26/10 μm .*

Description: Valves linear, broadly rounded at poles, length 13 μm , breadth 4.5 μm . Linear axial area narrow, striae perpendicular to the median line, radial at the terminus, 23-26/10 μm .

***Caloneis brevis* (Gregory) Cleve var. *minutissima* Manguin ex Kociolek & Reviere**

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Holotype: pl. 2, fig. 20

Description: *Valvae ellipticae-lanceolatae ad extremitatum attenuatae-subrostratae, polis rotundatis. Longitudo 17 μm . Latitudo 6 μm . Striae radiales circa 18/10 μm . Linea longitudinalis hyalinus dilute manifestus.*

Description: Valves elliptical-lanceolate, attenuate-subrostrate at the extremities, poles broadly rounded, length 17 μm , breadth 6 μm , about 18 radial striae/ 10 μm , hyaline longitudinal line slightly apparent.

***Caloneis patagonica* (Cleve) Cleve var. *alaskensis* Manguin ex Kociolek & Reviere**

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Holotype: pl. 2, fig. 21

Description: *Valvae lineares-lanceolatae. Longitudo 41-42 μm . latitudo 7-8 μm . Area axialis occupans dilute plus quam 1/3 latitudinem valvae. Striae radiales 15-16/10 μm . Linea longitudinalis accedens aream axialem.*

Description: Valves linear-lanceolate, length 41-42 μm , breadth 7-8 μm . Axial area occupies slightly more than 1/3 the breadth of the valve. Radial striae 15-16/10 μm ; longitudinal lines approaches the axial area.

***Pleurosigma longum* Cleve var. *inflatum* H. Peragallo f. *minus* Manguin ex Kociolek & Reviere**

(*P. longum* Cleve var. *inflata* H. Peragallo f. *minor* Manguin nom. nud.)

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Holotype: pl. 6, fig. 11, 12 (these two figures are of the same specimen)

Descriptio: Longitudo 127-148 μm . Latitudo 23-26 μm . Striae obliquae 15/10 μm . Striae transversalis 16-17/10 μm . Dimensiones parvior quam P. longum var. inflata f. inflata.

Description: Length 127-148 μm , breadth 23-26 μm , 15 oblique striae and 16-17 transverse striae in 10 μm . Dimensions smaller than that of the variety.

***Amphora hilliardii* Manguin ex Kociolek & Reviere**

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Holotype: pl. 2, fig. 24

Descriptio: Valvae margine dorsali valde arcuata, in margine ventrali dilute tumida, ad extremitatum abrupte constrictae tum amplificatae insigniter, ad polis truncatis. Longitudo 19.5 μm . Latitudo 19.5 μm . Latitudo ad medietatem 5 μm , ad polis 2.5 μm . Area axialis angusta. Area centralis nulla. Rami raphis dilute obliqui ad poros centrales non nisi incurvati. Striae dorsales circa 23-26/10 μm ad extremitatum plus quam 30/10 μm . Striae medianae prope marginem valvae interruptae spatio striato subtiliter in margine dorsali. Margo ventralis non-striatus.

Description: Valves with dorsal margin strongly arched, weakly tumid on the ventral margin, abruptly constricted at the extremities then notably enlarged; poles truncate, length 19.5 μm , breadth at median 5 μm , 2.5 μm at poles. Axial area narrow; central area lacking. Raphe branches weakly oblique, incurved only at the central pores. Dorsal striae about 23-26/10 μm , more than 30/10 μm at the extremities. The median striae are interrupted near the valve margin by a finely striated space on the dorsal border; ventral border non-striated.

***Amphora parallelistriata* Manguin ex Kociolek & Reviere**

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Holotype: pl. 2, fig. 25

Descriptio: Valvae margine dorsali arcuata, margine ventralis rectus ad extremitatum dilute depressae, polis rotundatis-obtusis. Longitudo 28 μm , latitudo 7.5 μm . Area axialis perangusta. Area centralis non nisi ad marginem ventralem extensa. Raphe recta. Striae dorsales parallelae 13/10 μm aperature elongatae formatae. Striae ventrales perabbreviatae 13/10 μm .

Description: Valves with dorsal margin arched, the ventral margin straight, slightly depressed at the extremities and poles rounded obtuse, length 28 μm , breadth 7.5 μm . Axial area very narrow, central area expanded only to the ventral margin. Raphe straight. Dorsal striae parallel, 13/10 μm formed by long dashes; ventral striae very reduced and the same number as the dorsal.

***Cymbella aequalis* Wm. Smith in Greville var. *alaskensis* Manguin ex Kociolek & Reviere**

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Holotype: pl. 2, fig. 26

Descriptio: Valvae dimorphae plerumque, symmetricae vel plus minusve asymmetricae, vel ellipticae, vel margine ventrali plus minusve in parte mediana recta, polis late rotundatis. Longitudo 16-19 μm . Latitudo 7-8 μm . Area axialis linearis-lanceolata. Area centralis

certa ordinate. Raphe centralis vel dilute excentrica. Striae radiales, striis medianis perpendicularis interdum et circum nodulum centralem plerumque incurvatis, partem medianam 9-12/10 μ m et ad extremitatum 15-22 μ m.

Description: Valves frequently dimorphic, symmetrical to more or less asymmetrical, to contoured regularly elliptical or to the ventral margin more or less straight in the median part, broadly rounded at the poles, length 16-19 μ m, breadth 7-8 μ m, axial area linear-lanceolate, central area regularly delimited. Raphe central or weakly excentric. Striae radial, the median striae sometimes perpendicular and frequently incurved around the central nodule, 9-12/10 μ m at the median part and 15-22/10 μ m towards the extremities.

Comments: Manguin provided four figures for this taxon (pl. 2, figs 26-29), and we have selected one of these to serve as the neotype.

***Cymbella austriaca* Grunow in Schmidt et al. var. *semirecta* Manguin ex Kociolek & Revers**

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Holotype: pl. 3, fig. 1

Descriptio: *Valvae asymmetricae in margine dorsali convexae in margine ventrali rectae. Longitudo 65 μ m. Latitudo 15 μ m. Striae radiales. Striae medianae in latere dorsali 9-10/10 μ m et in latere ventrali 13/10 μ m, distincte lineatae. Raphe lateralis, undulatae prominenter.*

Description: Valves asymmetrical convex on the dorsal margin, straight on the ventral margin. Length 65 μ m, breadth 15 μ m. Striae radial, the median striae 9 in 10 μ m on the dorsal side and 13 in 10 μ m on the ventral side, distinctly lineate. Raphe with accentuated undulations with accompanying lines.

***Cymbella cistula* Hemprich in Hemprich & Ehrenberg var. *globosa* Manguin ex Kociolek & Revers**

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Holotype: pl. 3, fig. 3

Descriptio: *Valvae ambitu pertunato, margine ventrali incurvo ad extremitatum et in medio tumido. Longitudo 33-47 μ m. Latitudo 14-16 μ m. Striae medianae dorsales 13/10 μ m et ventrales 8/10 μ m.*

Description: Valves with very accentuated lunate outline, ventral margin incurved at the extremities and tumid at the middle, length 37-47 μ m, breadth 14-16 μ m, median striae dorsal and ventral 13 in 10 μ m and 8 in 10 μ m, respectively.

***Cymbella frenguelli* Manguin ex Kociolek & Revers**

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Holotype: pl. 3, fig. 5

Descriptio: *Valvae symmetricae ellipticae-lanceolatae, ad extremitatum dilute constrictae, polis late rotundatis. Longitudo 78 μ m. Latitudo 14.5 μ m. Area axiali lanceolata in medio valvae occupans quase 1/3 latitudinem valvae. Raphe lateralis ramis abrupte*

inflexis versus nodulum centralem. Striae radiales punctatae, puncta 23/10 µm. Striae medianae 18/10 µm. Striae terminales 22-24/10 µm.

Description: Valves symmetrical, elliptical-lanceolate, weakly constricted at the extremities, broadly rounded at the poles, length 78 µm, breadth 14.5 µm. Axial area lanceolate occupies towards the middle of the valve slightly more than 1/3 the breadth of the valve. Raphe with accompanying line, branches abruptly inflexed towards the central nodule. Striae radial, punctate, the median striae 18 in 10 µm, the terminal striae 22-24 in 10 µm; 23 puncta in 10 µm.

***Cymbella hilliardii* Manguin ex Kociolek & Reviere**

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Holotype: pl. 3, fig. 6

Descriptio: Valvae asymmetricae ellipticae-lanceolatae et ad extremitatum rostratae, margine dorsali plus convexo quam margine ventrali. Longitudo 34 µm. Latitudo 9 µm. Area axialis lanceolata. Raphe recta excentrica rima polari incurvato versus latus ventralem. Striae radiales structura absenti. Striae dorsales et ventrales 12-13/10 µm ad partem medianam, circa 15/10 ad extremitatum.

Description: Valves asymmetrical, elliptical-lanceolate and rostrate at the extremities, the dorsal margin more convex than the ventral, length 34 µm, breadth 9 µm. Axial area lanceolate. Raphe straight, excentric with polar slit incurved towards the ventral side. Radial striae without apparent structure, respectively, the dorsal striae and the ventral striae 12-13 in 10 µm in the median part, about 15 in 10 µm towards the extremities.

***Cymbella lacus-karluki* Manguin ex Kociolek & Reviere**

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Holotype: pl. 3, fig. 7

Descriptio: Valvae asymmetricae in margine dorsali convexae, in margine ventrali rectae ad polis late rotundatis. Longitudo 28.5 µm. Latitudo 6.5 µm. Area axialis lanceolata. Area centralis elliptica in longitudinem et latitudinem. Rami raphis distincte obliquus et valde incurvus versus nodulum centralem. Striae radiales structura absenti. Striae dorsales medianae 9/10 µm et striae ventrales 10-11/10 µm. Puncta 2 mediana in latere ventrali sejuncta.

Description: Valves asymmetrical, convex on the dorsal margin and straight on the ventral margin, broadly rounded at the poles, length 28.5 µm, breadth 6.5 µm. Axial area lanceolate; central area elliptical in length and breadth. Raphe branches clearly oblique and strongly incurved towards the central nodule. Radial striae without structure, dorsal median striae 9 in 10 µm and ventral striae 10-11 in 10 µm. Two isolated median points on the ventral side.

***Gomphonema alaskensis* Manguin ex Kociolek & Reviere**

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Holotype: pl. 3, fig. 9

Descriptio: Valvae clavatae, in partem medianam distincte dilatae, ad extremitatum

gradatim angustatae. Capiti-polus late rotundatus. Basi-polus amplificatus et subcapitatus, ad extremam constrictus. Longitudo 39 µm. latitudo 10.5 µm. Area axialis lanceolata. Area centralis subcircularis. Raphe undulata poris centralibus permanifestis. Striae radiales lineatae longitudine inaequali circum nodulum centralem, 12/10 µm. Puncta sejuncta destituta.

Description: Valves claviform, noticeably dilated in the median part, gradually narrowed towards the extremities, headpole broadly rounded, constricted to the end of the footpole, this enlarged and subcapitate, length 39 µm, breadth 10.5 µm. Axial area lanceolate, central area subcircular. Raphe undulate with central pores obviously apparent, striae radial, lineate, of unequal length around the central nodule, 12 in 10 µm. No isolated puncta.

***Gomphonema drouetii* Manguin ex Kociolek & Reviere**

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Holotype: pl. 3, fig. 10

Description: Valves clavatae crassae, in parte mediana valde dilatatae ad extremitatum gradatim angustatae. Capito-polus late rotundatus. Basi-polus amplificatus, subcapitatus ad extremitatum constrictus. Longitudo 25 µm. Latitudo 9 µm. Area axialis lanceolata circum nodulum centralem distincte amplificata. Raphe recta, ramis versus poros centrales incurvatus. Striae radiales structura absenti, 13/10 µm. Striae medianae longitudine aequali. Punctum sejunctum in 1 latere noduli centralis.

Description: Valves stocky clavate, strongly dilated in the median part, gradually narrowed towards the extremities, headpole broadly rounded constricted to the end to the footpole, this last enlarged and subcapitate, length 25 µm, breadth 9 µm. Axial area lanceolate notably enlarged around the central nodule. Raphe straight, the branches incurved to the central pores. Striae radial without apparent structure, 13 in 10 µm, the median striae of equal length towards an isolated point on one side of the central nodule.

***Gomphoneis quadripunctata* (Ørstrup) Dawson ex Ross & Sims var. *cochleariformis* Kociolek & Stoermer 1991, p. 1570, figs 115, 129, 130**

The diatom presented by Manguin as *Gomphonema olivaceoides* var. *cochleariformis* (Manguin, p. 282, pl. 3, fig. 14; pl. 5, fig. 8) was subsequently encountered in Lake Superior and validly described by Kociolek & Stoermer (1991).

***Gomphonema olivaceoides* Hustedt var. *lanceolatum* Manguin ex Kociolek & Reviere**

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Holotype: pl. 3, fig. 15

Description: Valvae elongatae lanceolatae. Capiti-polus et basi-polus rotundatus, latitudine fere aequalibus. Longitudo 36.5 µm. latitudo 5.5 µm. Striae circa 13/10 µm.

Description: Valves stretched lanceolate, head and footpoles rounded and nearly equal in breadth, length 36.5 µm, breadth 5.5 µm, about 13 striae in 10 µm.

***Denticula elegans* Kützing var. *lucus-karluki* Manguin ex Kociolek & Reviere**

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Holotype: pl. 3, fig. 16**Description:** *Valvae ellipticae ad polistate rotundatis. Longitudo 16 µm. Latitudo 5 µm. Septa transapicalia 5-6/10 µm. Striae punctatae grosse 20-23/10 µm.***Description:** Valves elliptical, broadly rounded at poles, length 16 µm, breadth 5 µm, 5-6 transapical partitions and 20-23 grossly punctate lines in 10 µm.***Nitzschia lucus-karluki* Manguin ex Kociolek & Reviere**

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Holotype: pl. 4, figs 1, 2 (these two figures are of the same specimen)**Description:** *Valvae longissimae linearis-lanceolatae ad extremitatum constrictae-rostratae, polis rotundatis. Longitudo 211 µm. Latitudo 8.5 µm. Carina excentrica, non ad partem medianam. Puncta carinalia robustae 6-7/10 µm. Striae delicatae, magnificatione valida non nisi visibiles, 35/10 µm.***Description:** Valves very long, linear-lanceolate, constricted-rostrate at the extremities, poles rounded, length 211 µm, breadth 8.5 µm, keel excentric not returning towards the median part, keel puncta robust 6-7 in 10 µm. Striae delicate, visible only (hyrax) with high magnification, 35 in 10 µm.***Surirella biseriata* Brébisson var. *spinifera* Manguin ex Kociolek & Reviere**

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Holotype: pl. 5, fig. 11**Description:** *Valvae ellipticae-lanceolatae. Longitudo 131-155 µm. Latitudo 43-54 µm. Canales 15-20/100 µm. Pagina valvae spinis parvis.***Description:** Valves elliptical-lanceolate, length 131-155 µm, breadth 43-54 µm, 15-20 canals in 100 µm. Surface of the valves covered with small spines.**Comment:** Manguin provided three figures for this taxon (pl. 4, fig. 4, pl. 5, figs 10, 11), and we have selected one that represents an actual specimen as the holotype.***Surirella hannai* Kociolek & Reviere****(*S. laevis* Manguin nom. nud.)**

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Holotype: pl. 4, fig. 6**Description:** *Valvae isopolaes lineares-ellipticae polis rotundatis-obtusis. Longitudo 46 µm. latitudo 10 µm. Ala planitiei valvae fere perpendicularis, projecturis distinctis destitutis. Canales alarum non quam grandes fenestram, 20-22/100 µm. Paries cellulae structura manifesta et pseudoraphe destituta.***Description:** Valves isopolar linear-elliptical with rounded-obtuse poles, length 46 µm, breadth 10 µm. Wing slightly near perpendicular to valvar plane, without distinct projections. Alar canals not so large, fenestrae 20-22 in 100 µm. Cell wall without either apparent structure or pseudoraphe.

Comment: Manguin had originally used the name *S. laevis*, but it is occupied both by *S. laevis* Kützing and *S. laevis* Cleve-Euler. We name this diatom for Margaret Hanna of the California Academy of Sciences.

***Surirella linearis* Wm. Smith var. *lacus-karluki* Manguin ex Kociolek & Revers**

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Holotype: pl. 4, fig. 8

Description: *Valvae lineares ad lineares-ellipticae, polis rotundatis-obtusis. Longitudo 58-85 µm. Latitudo 18-25 µm. Projecturae alarum admodum manifestae. Canales circa 15-20/100 µm, latitudine eadem modo ac fenestram. Pagina valvae inter marginem alarum et lineam medianam leviter inferna. Membrana striata subtiliter et spinis pusillis impleta.*

Description: Valves linear to linear-elliptical, rounded-obtuse at the poles, length 58-85 µm, breadth 18-25 µm. Alar projections quite apparent, about 15-20 canals in 100 µm, the same as the fenestrae. Surface of the valve between the margin of the wings and the median line noticeably lower. Finely striated membrane and filled with small spines.

Comment: Manguin provided two illustrations of this taxon (pl. 4, figs 7, 8), and we have chosen the one that provides greater detail of this diatom.

***Surirella robusta* Ehrenberg var. *bispinosa* Manguin ex Kociolek & Revers**

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Holotype: pl. 4, fig. 9

Description: *Valvae heteropolaris leviter. Longitudo 207-209 µm. Latitudo 61 µm. Canales 10-20/100 µm. Linea mediana spina robusta uncata et subterminali ad extremitatem.*

Description: Valves heteropolar slightly marked length 207-209, breadth 61 µm, 10-20 canals in 100 µm. Median line with a robust spine hooked and subterminal at the extremities.

***Surirella tenera* Gregory f. *manguini* Kociolek & Revers
(*S. tenera* f. *punctata* Manguin nom. nud.)**

Page 284

Holotype: pl. 5, fig. 13

Description: *Longitudo 137 µm, latitudo 38 µm. Canales 19-20/100 µm. Paries cellulae punctis numerosis tectus.*

Description: Length 137 µm, breadth 38 µm; 19-20 canals in 100 µm; cell wall strewn with numerous projections.

Comment: Manguin had used the name *Surirella tenera* f. *punctata*, but that name is preoccupied by *S. tenera* f. *punctata* Skvortzow.

***Surirella turgidoides* Manguin ex Kociolek & Reviere**

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Holotype: pl. 5, fig. 14

Description: *Valvae ellipticae-lanceolatae, heteropolaris leviter polis rotundatis-obtusis. Longitudo 109-112 µm. Latitudo 41-42 µm. Alae et projecturae admodum manifestae. Canales alarum parvior quam fenestra, 11-14/10 µm. Latera leviter prolongata in cursum lineae medianae. Linea mediana ad extremitatum vena projecta. Valvae inter lineam medianam et marginem alae leviter infernae. Membrana striata, 25-27/10 µm, spinis pusillis impleta.*

Description: Valves with heteropolarity slightly emphasized with a elliptical-lanceolate contour, poles rounded-obtuse, length 109-112 µm, breadth 41-42 µm, wing and projections very apparent, alar canals less large than the fenestrae 11-14 in 100 µm. Sides slightly prolonged in the direction of the median line, the latter has present a vane projecting at the extremities. Valves weakly lower between the median line and the border of the wing; striated membrane 25-27 striae in 10 µm, covered with small spines.

ACKNOWLEDGEMENTS — This project was funded in part through an invited professorship to JPK from the Muséum National d'Histoire Naturelle, Paris. Drs Richard Moe, University of California, Berkeley, and Horst Lange-Bertalot, J.W. Goethe-Universität, provided constructive reviews. Dr Paul Silva, University of California, Berkeley, kindly provided access to the *Index Nominum Algarum*.

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THE DIATOM TYPES OF EMILE MANGUIN. II. VALIDATING DESCRIPTIONS AND DESIGNATION OF TYPES FOR THE NEW CALEDONIA SPECIES.

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ABSTRACT — The 61 taxa described as new by Emile Manguin in his 1962 paper on diatoms from New Caledonia lacked Latin descriptions and type designations; they are therefore invalid according to the International Code of Botanical Nomenclature. We provide Latin descriptions for Manguin's taxa and, based on his original designations on his slides, identify holotypes. Holotypes for several species were not indicated by Manguin, and we have therefore designated holotypes from Manguin's slides. Specimens of nine taxa could not be found, and Manguin's illustrations are designated as holotypes for three of them where original material has been lost. The remaining six taxa could not be located in the extant Manguin material, and they have been left undescribed. English translations of the original French descriptions are also provided.

RÉSUMÉ — Dans son article de 1962 sur les diatomées de Nouvelle Calédonie, Emile Manguin a décrit 61 nouveaux taxons, mais sans accompagner ses descriptions de diagnoses latines et sans désigner de types ; ils sont donc invalides selon le code international de nomenclature botanique. Nous fournissons une diagnose latine pour chacun des taxons de Manguin et, sur la base de ses désignations originales de ses lames, nous avons identifié les holotypes. Pour plusieurs espèces, les holotypes n'ont pas été indiqués par Manguin et nous les avons donc désignés dans ses lames. Des spécimens de 9 taxons n'ont pas pu être trouvés et, pour 3 d'entre eux dont le matériel a été perdu, les illustrations originales de Manguin ont été désignées comme holotype. Les 6 taxons restant n'ont pu être retrouvés dans le matériel existant et ont été laissés sans description. Des traductions en anglais des descriptions originales en français ont aussi été fournies.

KEY WORDS: Bacillariophyceae, diatom, taxonomy, nomenclature, type, New Caledonia, Manguin.

INTRODUCTION

Manguin identified a total of 61 new taxa in his material from New Caledonia (Manguin 1962), yet he did not provide Latin descriptions nor did he designate types

for his new taxa. Due to these deficiencies in compliance with Articles 32.1, 36 and 37 of the International Code of Botanical Nomenclature (Greuter *et al.* 1994), Manguin's taxa are considered invalid. In this paper designations of types and Latin descriptions are provided to validate Manguin's taxa. Of the 19 samples examined by Manguin to produce his treatise (pp. 2, 3), slides (without material) were found at the Laboratoire de Cryptogamie, Muséum National d'Histoire Naturelle, Paris (PC), representing 17 samples. In Table 1 are listed the station numbers as indicated by Manguin and the slide numbers in PC. Written on the slides, in Manguin's hand, there are designations for 37 of the 61 new taxa. In addition, 15 of the new taxa not designated on the slides by Manguin have been identified and we have designated holotype slides for these taxa. Cases where holotypes have been chosen by us are designated by an asterisk. A total of nine taxa could not be identified in the Manguin material. Three of these taxa, *Melosira neocaledonica*, *M. solitaria* and *Stauroneis neocaledonica*, have Manguin's original illustrations designated as holotypes (as provided for in Article 8.3 of the ICBN), since they were identified from material that has subsequently been lost (sample 14 of Manguin). The six remaining taxa for which specimens could not be found in the original Manguin material, including *Achnanthes pseudolanceolata*, *Cymbella maillardii*, *Didymosphenia geminata* (Lyngbye) M. Schmidt in Schmidt *et al.* var. *neocaledonica*, *Navicula contentaeformis*, *N. pseudotenera*, and *N. subrhynchocephala* Husted f. *robusta*, have not been described in this work. In addition, several of Manguin's epithets would have been later homonyms at the time they presented in the 1962 publication. For these taxa, we have presented new names. All type specimens are deposited at PC.

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1. Creek Crevecoeur; AD7648, AD7664, AD7665, AD7681, AD7682.
 2. Néhoué AD7666, AD7667
 3. Koniambo, rocher suintant; AD7654, AD7655, AD7656, AD7657
 4. Koniambo, exp. mousse; AD7639, AD7640, AD7658, AD7659, AD7660, AD7661, AD7662
 5. Anse Vata; AD7651.
 6. Anse Vata, Lemna; No slides exist
 7. Pain de Sucre; AD7668.
 8. Sanatorium; AD7641, AD7642, AD7643.
 9. Plaine des Lacs; AD7649, AD7650.
 10. Haute Hienghène, Mousses exp.; AD7632, AD7633, AD7634, AD 7635.
 11. Haute Hienghène, *Eichhornia*; AD7672, AD7673, AD7674, AD7675
 12. Col des Roussettes; AD7636, AD 7637, AD7638.
 13. Ile Hugon; AD7644, AD7645, AD7663.
 14. Mè Améri, mer; No slides exist
 15. Mè Améri, Palmiers; AD7679, AD7680
 16. Bourail, expr. d'*Eichhornia*; AD7646.
 17. Haute Ouinné; AD7647
 18. Col de Plum; AD7669, AD7670, AD7671.
 19. Haute vallée, creek Pernod; AD7676, AD7677, AD7678
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Table 1. Station Number, station description and PC Diatom Collection slide numbers for Manguin slides used in 1962 publication.

Pagination under each taxon name indicates the page in Manguin (1962) where his description appears. The sample numbers in which Manguin reported the

species to occur are also listed after each taxon. We also provide translations of Manguin's descriptions into English and offer comments on the nomenclature of the taxa.

Recently, Moser *et al.* (1995) have treated the freshwater diatoms from New Caledonia, based primarily on the collections of Maillard. In their treatment, several species of Manguin are considered. Moser *et al.* recognized that Manguin's species were not validly published, and in some cases designated neotypes, although they did not validate the species with Latin descriptions. Since original material for these species is extant, and validation of Manguin's taxa was not accomplished by Moser *et al.* (1995), names in their work are superfluous.

NEW TAXA, DESCRIPTIONS AND TYPE DESIGNATIONS

Melosira guillauminii Manguin *ex* Kociolek & Reviers

Page 13, pl. 1, fig. 1a-f

Sample: 9

Holotype: AD7649

Description: *Cellulae conjunctae in catenis individuorum 2-3, sed saepissime sejunctae, praesertim post tractationem materiae lectae. Diameter 9-12 µm. Axis pervalvaris dimidii cellulae vegetativae 4.5 µm altus, dividens usque ad 8.5 µm. Limbus valvae pariete crasso punctis paucis sparsis ornato. Pleurae variabiles secundum numerum divisionum successivarum. Pseudosulcus dilute visibilis; sulcus margo faucesque absunt. Discus valvaris punctis paucis ornatus, area centrali hyalina irregulatin delineata et trientem diametri disci occupante.*

Description: Cells united in chains of 2-3 individuals, but more often in an isolated state, especially after treatment of the harvested material for usual fixation. Diameter 9-12 µm, height of the pervalvar axis of a half cell in the vegetative state 4.5 µm, up to 8.5 µm when a cell is dividing. Valve mantle wall thickened, ornamented with a few sparse puncta, connective bands variable according to the number of successive divisions. Pseudosulcus slightly apparent, sulcus edge and gorge absent. Valve disk has few puncta with a hyaline central zone occupying a third of the diameter of the disk and irregularly delimited.

Melosira neocaledonica Manguin *ex* Kociolek & Reviers

Page 13, pl. 1, fig. 3

Sample: 14

Holotype: Pl. 1, fig. 3

Description: *Cellulae in catenis individuorum 2-3 conjunctae, cylindricae, convexae ad remitates, diametro 9 µm; axis pervalvaris dimidii cellulae 5-6 µm altus. Limbus valvaris numero variabili pleurarum undulatarum; pseudosulcus profundus marginem versus accrescens. Sulcus et margo undulata sine fauce manifesta. Disci valvares vicini conjuncti per spinas lamellosas ad marginem locatas.*

Description: Cells united in chains of 2-3 individuals, cylindrical, convex at their extremities, diameter 9 µm, height of the pervalvar axis of a half-cell 5-6 µm. Valve

mantle with a variable number of undulate connective bands, pseudosulcus deep large towards the margin, sulcus and edge undulate, without apparent gorge. Neighboring valve disk walls united by the lamellose spines situated along their margins.

***Melosira solitaria* Manguin ex Kociolek & Reviere**

Page 13, pl. 1, fig. 2a, b

Sample: 14

Holotype: Pl. 1, fig. 2a, b

Descriptio: *Cellulae solum solitariae visae, cylindricae et maxime convexae ad extremitates, diametro 7.5-8 μ m; axis pervalvaris dimidii cellulae 6 μ m altus. Valvae hemisphaericae obtegentes limbo pleuris numerosis instructo. Sulcus parum constrictus; margo aliquantum manifesta. Discus valvaris spinis minutis in area centrali; in centro membrana canalibus tenuissimis trans crassitudinem perforata.*

Description: Cells observed solely in the isolated state, cylindrical and highly arched at their extremities, diameter 7.5-8 μ m, height of the pervalvar axis of a semi-cell 6 μ m, valves hemispherical covered by a mantle with numerous connective bands, sulcus slightly constricted and edge quite apparent. Valve disk supplied with small spines situated on the central zone, membrane is crossed in height and in the middle of the disk by very fine canals.

***Cyclotella iridioides* Manguin ex Kociolek & Reviere**

Page 14, pl. 1, fig. 5

Sample: 1

Holotype: AD7665

Descriptio: *Valvae ovaes-ellipticae. Longitudo axium 15 X 11.5 μ m. Area marginalis, in latere interno, linea umbrosa manifestissima marginata. Area centralis elliptica irregularis, latitudine triente axis parvi valvae, subtiliter reticulata et punctulata. Striae costas robustas formantes, circa 12 in 10 μ m, ad coronam umbrosam leviter amplificatae, et ibi omnes spinam parvam satis manifestam ferentes.*

Description: Valves oval-elliptical, length of the axes 15 μ m by 11.5 μ m. Marginal zone circumscribed on the interior margin by a quite apparent shadow line. Central zone irregularly elliptical, about a 1/3 of the length of the smaller valve axis, travelling from a finely meshed reticulate network strewn with small puncta. Striae in the form of robust ribs, about 12 in 10 μ m, slightly enlarged up to the level of the shadow crown, present at each one at this same level a small spine is apparent.

***Cyclotella neocaledonica* Manguin ex Kociolek & Reviere**

Page 14, pl. 1, fig. 7a-c

Samples: 2, 14, 16

Holotype: *AD7646

Descriptio: *Frustula manifeste cuneiformia in aspectu cingulari. Valvae heteropolares, latere ventrali recto, latere dorsali convexo, leniter attenuatae polum angustiores versus.*

polo altero late rotundato. Longitudo valvarum 17-28 µm, latitudo maxima 3.5-4 µm. Striae 16 in 10 µm, densiores et obliquae circum nodulos terminales.

Description: Frustules clearly cuneiform in girdle view. Valves heteropolar rectilinear on the ventral margin, convex on the dorsal margin and imperceptibly attenuate in the direction of the more straight poles, opposite this is largely rounded, length 17-28 µm, maximum breadth 3.5-4 µm. 16 striae in 10 µm, more condensed and with an oblique direction around the terminal nodules.

Comment: Moser *et al.* (1995) designated a neotype (PC, Collection Maillard No. 18/1, Source de ruisseau du Mont Dogny) for this taxon, but did not provide a validating description.

***Eunotia fallax* Cleve var. *bacillum* Manguin ex Kociolek & Reiers**

Page 15, pl. 1, fig. 8

Sample: 9

Holotype: AD7649

Description: *Valvae arcuatae, lateribus parallelis usque ad extremitates, polis late rotundatis. Longitudo valvarum 28-29.5 µm, latitudo 1.5-2 µm. Striae 9-10 in 10 µm.*

Description: Valves arched with parallel margins until the extremities, poles largely rounded, length 28-29.5 µm, breadth 1.5-2 µm, 9-10 striae in 10 µm.

Comment: The slide label indicates "*Eunotia exigua* var. *bucillum*".

***Eunotia fallax* Cleve var. *vermicularis* Manguin ex Kociolek & Reiers**

Page 15, pl. 1, fig. 9

Sample: 9

Holotype: AD7649

Description: *Valvae latere ventrali leniter concavo, latere dorsali convexo, paulo contractae et plus minusve longe prolongatae ad extremitates, polis rotundatis, 15.5 µm longae, 2.5 µm latae; striae 8-9 in 10 µm, inter se dissitiores illis varietatis superioris.*

Description: Valves weakly concave along the ventral margin, convex along the dorsal, slightly constricted and extended at the extremities, poles rounded. Length 15.5 µm, breadth 2.5 µm, striae even more distant than in var. *bacillum*, 8-9 in 10 µm.

Comment: Slide label indicates "*Eunotia exigua* var. *vermicularis*".

***Eunotia monodon* Ehrenberg var. *neocaledonica* Manguin ex Kociolek & Reiers**

Page 15, pl. 1, fig. 10a, b

Samples: 6, 7

Holotype: AD7651

Description: *Valvae latere ventrali recto in area mediana concavo extremitates versus, latere dorsali convexo, plus minusve longe attenuatae prope polos, 58-78 µm longae, 9-10 µm latae. Striae 6-9 in 10 µm in area mediana, 12-13 in 10 µm prope polos. Sine pseudoraphe parallela secus marginem ventralem.*

Description: Valves with ventral margin straight on the median part and becoming

concave towards the extremities, dorsal margin convex, + longly attenuate near the poles, length 58-78 μm , breadth 9-10 μm , median striae 6-9 in 10 μm , 12-13 in 10 μm near the poles. No parallel pseudoraphe all along the length of the ventral margin.

Comment: Manguin indicated the presence of this species on a slide from sample 5, although it was listed from samples 6 and 7.

***Eunotia spiculaeformis* Kociolek & Reviere**

(*E. pseudolunaris* Manguin nom. nud.)

Page 15, pl. 1, fig. 12

Sample: 16

Holotype: AD7666

Descriptio: *Valvae leniter arcuatae, lateribus parallelis in area mediana, leviter attenuatae prope extremitates, polis rotundatis plus minusve obtusis et paulo contractis prope nodulos terminales qui polis manifeste distantes sunt. Raphe aliquantum prolongata parallele ad axem apicalem ut in Eunotia flexuosa (Bréb.) Kütz. Longitudo valvarum 61 μm , latitudo 4 μm . Striae puncticulosae, 11-13 in 10 μm , 16 in 10 μm ad extremitates.*

Description: Valves weakly arched with parallel margin on the median part, imperceptibly attenuate towards the extremities, rounded poles + obtuse and slightly constricted at the level of the terminal nodules, the latter visibly receding at the poles. Raphe slightly extends parallel to the apical axis, as in *E. flexuosa* (Bréb.) Kütz., length 61 μm , breadth 4 μm , 11-13 striae in 10 μm , finely punctate, 10-16 in 10 μm at the extremities.

Comments: Use of the original epithet of Manguin (*E. pseudolunaris*) would make this name a later homonym of a species described by Venkataraman (1939). Although Van Landingham (1969, p. 1553, 1558) offered a new name, *E. neocaledonica* Van Landingham, for Manguin's species, neither name has nomenclatural status. This species was reported from sample 16, but our holotype is from sample 2.

***Achnanthes neocaledonica* Manguin ex Kociolek & Reviere**

Page 16, pl. 1, fig. 14a, b

Samples: 15, 16

Holotype: *AD7647

Descriptio: *Valvae longae lineares-lanceolatae, valde constrictae-capitatae ad extremitates, polis late rotundatis, 47-57 μm longae, 4-5 μm latae. Araphovalva pseudoraphe lineari perangusta, parum amplificata prope medium, striis radialibus in medio, perpendicularibus extremitates versus, 20-22 in 10 μm , striis 2 vel 3 centralibus aliis robustioribus. Raphovalva raphe recta valde manifesta, area axiali recta satis ampla, angustata ad constrictionem terminalem, ad polos ampliata instar areae parvae polaris; area centrali instar fasciae amplae rectangularis latera valvae attingenti; striis omnibus radialibus numero illas valvae oppositae aequantibus.*

Description: Valves linear-lanceolate, strongly constricted-capitate at the extremities, broadly rounded at poles, length 47-57 μm , breadth 4-5 μm . Valves without raphe have a linear pseudoraphe very narrow slightly enlarged towards the middle; median striae radial becoming perpendicular towards the extremities, 20-22 in 10 μm the 2-3 central

striae more robust than the next. Valve with raphe has straight raphe that is quite apparent, axial area straight and relatively large, then becomes narrow contracted going to the valve terminus; enlarges noticeably at the poles in a small polar area. Central area a large rectangular band reaching the border of the valve. Striae entirely radiate and of the same number as the opposite valve.

Comment: This holotype is from sample 17 although this species was reported from samples 15 and 16. Moser *et al.* (1995) designated a neotype (PC, Collection Maillard No. 38/3, Rivière des Lacs) for this taxon, but did not provide a validating description.

Diatomella parva Manguin *ex* Kociolek & Reviers

Page 16, pl. 2, fig. 1

Sample: 6

Holotype: *AD7668

Description: *Frustula solum in aspectu cingulari observata, itaque diagnosis hujus Diatomellae novae incompleta est. In hac positione cellula dimidia frustuli protuberationes duas noduliformes in medio perforatas praebet. Protuberationes pleuram contingunt et spacio aequanti circa trientem altitudinis axis apicalis separatae sunt. Longitudino 7.5 µm; striae circa 23 in 10 µm.*

Description: Frustules viewed only on the connective face, a consequence is the diagnosis of this new *Diatomella* is incomplete. The half cells of the frustule show in this position 2 nodule-like protuberances perforated in their central part, these half-cells are appressed on the wall of the intermediate bands and separate each other by a living space equal to about 1/3 of the height of the apical axis. Length 7.5 µm, about 23 striae in 10 µm.

Comment: Although reported by Manguin from sample 6 only, specimens in girdle view were observed from sample 7.

Mastogloia malayensis Hustedt *var. robusta* Manguin *ex* Kociolek & Reviers

Page 17, pl. 2, fig. 2; pl. 8, fig. 1

Sample: 18

Holotype: *AD7670

Description: *Valvae ellipticae-lanceolatae, attenuatae subrostratae ad extremitates, polis late rotundatis, 49-70 µm longae, 14-15 µm latae. Rami raphes valde undulati. Area axialis linearis angustata ad extremitates; area centralis late elliptica. Costae robustae radiales, 8-12 in 10 µm, lineis longitudinalibus sectae, circa 12-15 in 10 µm. Series partectarum leviter curvatae et satis remotae lateribus valvae; partectae rectangulares transversales, circa 6-7 in 10 µm.*

Description: Valves elliptical-lanceolate, attenuate subrostrate at the extremities, broadly rounded at the poles, length 49-70 µm, breadth 14-15 µm. Raphe branches strongly undulate. Linear axial area narrowed at the extremities; central area broadly elliptical. Ribs robust, radial, 8-12 in 10 µm, crossed by the longitudinal lines about 12-15 in 10 µm. Row of locula weakly curved and quite far from the border of the valve, locula rectangular, transverse about 6-7 in 10 µm.

***Amphipleura guillauminii* Manguin ex Kociolek & Reviere**

Page 17, pl. 2, fig. 3a, b

Samples: 18, 19

Holotype: AD7669

Descriptio: *Valvae longae lineares, attenuatae-rostratae ad constrictae et subcapitatae ad extremitates, polis late rotundatis, 80-139 µm longae, 6-7.5 µm latae. Rumi raphes longitudine circa trientem axis transapicalis aequantes. Striae transapicales 26-30 in 10 µm, perpendiculares linea mediana, ad extremitates convergentes, lineis tenuibus longitudinalibus sectae.*

Description: Valves longly linear, attenuate-rostrate to constricted and subcapitate at the extremities, poles broadly rounded, length 80-139 µm, breadth 6-7.5 µm. Length of the raphe branches equal to about 1/3 of the apical axis of the cell; 26-30 transapical striae in 10 µm, perpendicular to the median line, convergent at the extremities, crossed by delicate longitudinal lines.

Comment: Moser *et al.* (1995) designated a neotype (PC, Collection Maillard No. 43/4, Lac en Huit) for this taxon, but did not provide a validating description.

***Frustulia neocaledonica* Manguin ex Kociolek & Reviere**

Page 18, pl. 2, fig. 4a, b; pl. 8, fig. 4a-c

Samples: 18, 19

Holotype: AD7669

Descriptio: *Valvae rhomboideae-lanceolatae plus minusve protuberantes in parte mediana, rostratae ad constrictae-capitatae ad extremitates, 62-88 µm longae, 14-20 µm latae. Costa mediana robusta, aliquantum dilatata nodulum centrale versus, non constricta circum aream centralem cujus ambitus ellipticus ad subrhomboideus est. Noduli polares rima plus minusve manifesta. Striae transapicales omnes perpendiculares linea mediana, circa 26-30 in 10 µm, lineis tenuibus longitudinalibus sectae, circa 24-30 in 10 µm.*

Description: Valves rhomboid-lanceolate + bulging around the median part, rostrate to constricted-capitate at the extremities, length 62-88 µm, breadth 14-20 µm. Median rib robust, enlarged somewhat towards the central nodule, without constriction around the central area, the latter with an elliptical to subrhomboid contour, polar nodules with a slit + apparent. Transapical striae entirely perpendicular to the median line, about 26-30 in 10 µm, crossed by fine longitudinal lines, about 24-30 in 10 µm.

Comment: Moser *et al.* (1995) designated a neotype (PC, Collection Maillard No. 72/2, "Rivière Pernod") for this taxon, but did not provide a validating description.

***Stauroneis neocaledonica* Manguin ex Kociolek & Reviere**

Page 18, pl. 3, fig. 1a, b

Sample: 14

Holotype: Plate 3, figure 1

Descriptio: *Frustula latissima in aspectu cingulari. Valvae longissimae et anguste lanceolatae, leviter tumidae in parte mediana, abrupte constrictae ad parietes polares, tum cuneiformes polis rotundatis obtusis, 53-88 µm longae, 5 µm latae. Raphe recta linea non*

concomitata. Area axialis angusta linearis; area centralis notabiliter amplificata latera valvae versus. Parietes polares crassissimi bicurvati lateribus oppositis ambobus concavis. Striae leviter radiales in area mediana valvae, tum linea mediana perpendiculares, circa 16-18 in 10 μ m, punctis linearibus.

Description: Frustules very large in connective view. Valves very longly and narrowly lanceolate, slightly tumid around the median part, abruptly constricted at the level of the polar partitions, then cuneiform with poles rounded-obtuse, length 53-88 μ m, breadth 5 μ m. Raphe straight without accompanying line. Axial area narrow, linear; central area remarkably enlarged to the margin of the valve. Polar partitions very thick, doubly curved opposing anteriorly-posteriorly. Striae weakly radiate about the middle of the valve, then becoming perpendicular to the median line, a short dash, about 16-18 in 10 μ m.

Comment: Moser et al. (1995) consider *S. neocaledonica* a synonym of *S. frauenfeldianum* (Grunow) Heiden.

***Navicula muscora* Kociolek & Reviere
(*N. bryophiloides* Manguin nom. nud.)**

Page 19, pl. 2, fig. 5

Sample: 7

Holotype: *AD7668

Descriptio: Valvae ellipticae-lanceolatae, attenuatae subrostrataeque extremitates versus, 19.5 μ m longae, 3.5 μ m latae. Area axialis angusta, ad extremitates attenuata. Area centralis nonnihil manifesta, transverse irregulariter amplificata. Striae omnes radiales, in area mediana circa 23-26 in 10 μ m, in area terminali plus quam 30 in 10 μ m, circum aream centalem irregulariter abbreviatae.

Description: Valves elliptical-lanceolate, tapered and subrostrate towards the extremities, length 19.5 μ m, breadth 3.5 μ m. Axial area narrow, constricted at the extremities, central area slightly distinguished, irregularly enlarged transversely. Striae entirely radial, about 23-26 in 10 μ m around the median part, more than 30 in 10 μ m at the terminal part, irregularly shortened around the central area.

Comment: Use of the original epithet of Manguin (*N. bryophiloides*) would make this name a later homonym of his own species, described in Bourrelly & Manguin (1954, p. 27, pl. 3, fig. 31.). The name indicates association of this species with bryophytes.

***Navicula corticola* Manguin ex Kociolek & Reviere**

Page 19, pl. 2, fig. 7a, b

Sample: 9

Holotype: AD7649

Descriptio: Valvae ellipticae-lanceolatae, leviter constrictae subcapitataeque ad extremitates, polis rotundatis-obtusis, 13-16.5 μ m longae, 3.5-4.5 μ m latae. Raphe filiformis aliquantum curva prope poros centrales. Area axialis anguste lanceolata, aliquantum dilatata circum nodulem centalem. Striae subtiles, omnes radiales, in parte mediana 23-25 in 10 μ m, prope extremitates minimum 30 in 10 μ m; striae medianae saepissime longitudine aequales, raro irregulariter abbreviatae.

Description: Valves elliptical-lanceolate, slightly constricted and subcapitate at the extremities poles rounded-obtuse, length 13-16.5 μm , breadth 3.5-4.5 μm . Raphe filiform, a slight curve near the central pores. Axial area narrowly lanceolate, then slightly enlarged around the central nodule. Striae delicate, entirely radial, 23-25 in 10 μm around the median part, 30 and more in 10 μm at the extremities, more often the median striae are of equal length, rarely irregularly shortened.

Comment: Manguin lists this species also on slide AD7652, which is from sample 3. We have selected the slide from sample 9, the only sample indicated in his "Inventaire Systématique Général" where this species occurred.

Navicula eichhorniaephila Manguin ex Kociolek & Reviere

Page 19, pl. 2, fig. 8

Sample: 11

Holotype: AD7672

Descriptio: Valvae anguste lanceolatae, acutae productaeque ad extremitates, 35 μm longae, 5 μm latae. Raphe recta nonnihil manifesta. Area axialis asymmetrica, peranguste lanceolata, aliquantum dilatata circum nodulum centrale. Striae robustae, radiales in parte mediana, perpendiculares axe apicali prope extremitates, subtiliter lineatae, 10-11 in 10 μm . Stria centralis ad latus noduli centralis nonnihil visibilis et aliis brevior est.

Description: Valves narrowly lanceolate, acute and produced at the extremities, length 35 μm , breadth 5 μm . Raphe straight slightly apparent. Axial area asymmetrical, very narrowly lanceolate, enlarging some slightly around the central nodule. Striae robust radial around the median part then perpendicular to the apical axis towards the extremities, finely lineate, 10-11 in 10 μm , the central stria situated on one side of the central nodule is slightly visible and more short than its neighbors.

Navicula koniamboensis Manguin ex Kociolek & Reviere

Page 20, pl. 2, fig. 11

Sample: 3

Holotype: AD7654

Descriptio: Valvae ellipticae polis leviter rotundatis, 9 μm longae, 3.5-4 μm latae. Area axialis linearis angusta; area centralis vittiformis transverse dilatata. Striae leniter radiales, 23 in 10 μm , densiores prope extremitates, puncticulosae, punctulis in lineis longitudinalibus regularibus ordinatis.

Description: Valves elliptical with slightly rounded poles, length 9 μm , breadth 3.5-4 μm . Axial area linear, narrow; central area a transversely enlarged band. Striae weakly radial 23 in 10 μm , more condensed near the extremities, finely punctate, the puncta are disposed as regular longitudinal lines.

***Navicula stoermeri* Kociolek & Reviere**
(*N. marginestriata* Manguin nom. nud.)

Page 20, pl. 2, fig. 12

Sample: 16

Holotype: *AD7646

Description: Valvae ovals-elongatae, 10.5 μm longae, 5 μm latae. Raphe in sulco angusto lanceolato satis constricto circum nodulum centralem; rami raphes flexi poros centrales versus. Area axialis insigniter expansa. Striae brevissimae in serie marginali solum circa 1/7 maximae latitudinis valvarum occupanti, 23-24 in 10 μm , parallelae tum radiales prope polos.

Description: Valves oval-elongate, length 10.5 μm , breadth 5 μm , raphe placed within a narrow lanceolate slit noticeably constricted around the central nodule, raphe branches inflected towards the central pores. Axial area quite expanded. Striae very short positioned in one marginal row occupying 1/7 of the breadth of the valve, 23-24 in 10 μm , parallel then radial towards the poles.

Comment: Use of the original epithet of Manguin (*N. marginestriata*) would make this name a later homonym of a species described by Hustedt (1936). This diatom is named in honor Dr. E.F. Stoermer, University of Michigan, Ann Arbor.

***Navicula neocaledonica* Manguin ex Kociolek & Reviere**

Page 20, pl. 2, fig. 13

Sample: 14

Holotype: AD7646

Description: Valvae ellipticae-lanceolatae polis late rotundatis, 14.5 μm longae, 4 μm latae. Raphe recta filiformis. Area axialis linearis; area centralis circularis. Striae omnes radiales, illae circa aream centalem ordinate diminutae, circa 19 in 10 μm , usque ad 35 in 10 μm ad extremitates.

Description: Valves elliptical-lanceolate to the broadly rounded poles, length 14.5 μm , breadth 4 μm . Raphe straight filiform. Axial area linear. Central area circular. Striae entirely radial those disposed around the central area form it by becoming regularly shortened, about 19 in 10 μm to 35 in 10 μm at the extremities.

Comment: Manguin indicated the presence of this species on a slide from sample 16, but listed it from sample 14 only.

***Navicula perlucida* f. *angustata* Manguin ex Kociolek & Reviere**

Page 21, pl. 2, fig. 14

Sample: 9

Holotype: *AD7649

Description: Valvae hyalinae ambitu graciliore quam illo speciei (F. Hustedt, 1925-1937, p. 250, lam. XVII, fig. 43-44), 10 μm longae, 1.5 μm latae. Valvae 7 plo longiores quam latiores (4.5 plo in specie). Area axialis solum notata linea umbrosa aliquantum dilatata in parte centrali. Striae invisibiles.

Description: Valves hyaline with outline more slender than the species, length 10 μm , breadth 1.5 μm , yielding length/breadth = 7, the species = 4.5. Axial area marked only by a shadow line slightly enlarged in the central part, striae invisible.

***Navicula exasperans* Kociolek & Revers**
(*N. pseudocurta* Manguin nom. nud.)

Page 21, pl. 2, fig. 16

Sample: 18

Holotype: AD7673

Description: *Valvae lineares-ellipticae, extensae-subrostratae ad extremitates, polis rotundatis, 10.5 μm longae, 3.5 μm latae. Raphe recta manifesta solum prope poros centrales. Area axialis lanceolata. Striae radiales, circa 19 in 10 μm in area mediana, 22-23 in 10 μm ad extremitates.*

Description: Valves linear-elliptical, elongate-subrostrate at the extremities, poles rounded, length 10.5 μm , breadth 3.5 μm . Raphe straight, only apparent towards the central pores. Axial area lanceolate. Striae radial, about 19 in 10 μm in the median part, 22-23 in 10 μm at the extremities.

Comments: Use of the original epithet of Manguin (*N. pseudocurta*) would make this name a later homonym of a species described by Cholnoky (1955, p. 20, figs 31, 32), and the new name used here indicates how difficult it was to find a specimen. This holotype slide is from sample 11, while Manguin lists this species from sample 18 only.

***Navicula saxicola* Manguin ex Kociolek & Revers**

Page 22, pl. 2, fig. 19

Sample: 18

Holotype: *AD7670

Description: *Valvae structura subtilissima, lineares et longe extensae-subrostratae ad extremitates, polis rotundatis-obtusis, 14-20 μm longae, 3.5 μm latae. Raphe recta manifesta solum prope centrum valvae. Area axialis linearis-lanceolata, ad extremitates indistincta et raphe confusa. Striae haud distinctae.*

Description: Valves with a very delicate structure, linear and longly subrostrate at the extremities, rounded-obtuse poles, length 14-20 μm , breadth 3.5 μm . Raphe straight only apparent towards the center of the valve. Axial area linear lanceolate, becoming indistinct at the extremities where they merge with the raphe. Striae indiscernable.

***Navicula verecundaeformis* Manguin ex Kociolek & Revers**

Page 22, pl. 2, fig. 21a, b

Sample: 3

Holotype: AD7655

Description: *Valvae anguste lineares-lanceolatae, nonnihil extensae ad extremitates, polis late rotundatis, 7-12 μm longae, 2.5-4 μm latae. Area axialis anguste lanceolata; area centralis transverse et irregulariter dilatata, absens in specimenibus parvis. Striae radiales circa 23 in 10 μm , densiores ad extremitates.*

Description: Valves narrowly linear-lanceolate, slightly elongate at the extremities and broadly rounded at the poles, length 7-12 μm , breadth 2.5-4 μm . Axial area narrowly lanceolate. Central area transversely and irregularly enlarged, non exstant in small individuals. Striae radial, about 23 in 10 μm , the terminal striae are more condensed.

***Pinnularia divergens* Wm. Smith var. *malayensis* Hustedt f. *linearis* Manguin ex Kociolek & Reiers**

Page 23, pl. 3, fig. 4

Samples: 11, 18

Holotype: AD7671

Descriptio: *Valvae lineares aliquantum tumidae in parte mediana, ad extremitates late rotundatae et non subcapitatae, 112-123 μm longae, 18 μm latae; costae circa 8-10 in 10 μm .*

Description: Valves linear, slightly tumid around the median part, broadly rounded and not subcapitate at the extremities, length 112-123 μm , breadth 18 μm . About 8-10 ribs in 10 μm .

Comment: Manguin also lists this taxon on slide AD7670 from this same sample.

***Pinnularia gibba* Ehrenberg var. *cuneata* Manguin ex Kociolek & Reiers**

Page 23, pl. 4, fig. 4

Sample: 11

Holotype: AD7672

Descriptio: *Valvae lanceolatae, abrupte constrictae et rotundatae-cuneiformes ad extremitates, 58 μm longae, 9 μm latae; striae 10-11 in 10 μm .*

Description: Valves lanceolate, abruptly constricted and rounded-cuneiform at the extremities, length 58 μm , breadth 9 μm . 10-11 striae in 10 μm .

***Pinnularia intermedia* (Lagerstedt) Cleve var. *bryophila* Manguin ex Kociolek & Reiers**

Page 23, pl. 3, fig. 6

Sample: 10

Holotype: AD7634

Descriptio: *Valvae lineares lateribus parallelis in parte mediana, plus minusve longe attenuatae ad extremitates, polis late rotundatis, 20-23 μm longae, 3-4 μm latae. Area centralis elevatissima. Striae radiales, 8-10 in 10 μm , ad extremitates convergentes.*

Description: Valves linear with parallel sides in the median part, + elongate attenuate at the extremities with poles broadly rounded, length 20-23 μm , breadth 3-4 μm . Central area very expanded in height, radial striae becoming convergent towards the extremities, 8-10 in 10 μm .

***Pinnularia odiosa* Manguin ex Kociolek & Reviere**

Page 24, pl. 3, fig. 7

Sample: 10

Holotype: AD 7632

Descriptio: *Valvae angustae lateribus parallelis in parte mediana, leviter attenuatae extremitates versus, polis late rotundatis, 32-34 µm longae, 4.5-5.5 µm latae. Raphe recta, curva prope poros centrales. Area axialis late lanceolata; area centralis vittiformis aliquantum elevata. Striae omnes radiales, 16-20 in 10 µm.*

Description: Valves narrow with parallel sides in the median part, gradually attenuate towards the extremities with broadly rounded poles, length 32-34 µm, breadth 4.5-5.5 µm. Raphe straight, incurved near the central pores. Axial area broadly lanceolate, central area made of a transverse band, clearly elevated. Striae entirely radial 16-20 in 10 µm.

***Pinnularia subcapitata* Gregory var. *stauroneiformis* Van Heurck f. *subcuneata* Manguin ex Kociolek & Reviere**

Page 24, pl. 4, fig. 3

Sample: 16

Holotype: AD7646

Descriptio: *Valvae lineares-lanceolatae, attenuatae rostrataeque ad extremitates, polis rotundatis, 21 µm longae, 4.5 µm latae. Area centralis satis elevata. Striae 12 in 10 µm.*

Description: Valves linear-lanceolate, narrowing and rostrate at the extremities, poles rounded, length 21 µm, breadth 4.5 µm. Central area noticeably expanded in the direction of height, 12 striae in 10 µm.

***Caloneis aequatorialis* Hustedt var. *transitoria* Manguin ex Kociolek & Reviere**

Page 25, pl. 4, fig. 6a, b

Samples: 5, 7

Holotype: AD7639

Descriptio: *Longitudo valvarum 26-28 µm, latitudo 6-15 µm; striae 16-18 in 10 µm, leniter radiales, convergentes ad extremitates.*

Description: Length 26-28 µm, breadth 6-15 µm; 16-18 striae in 10 µm, weakly radial, convergent at the extremities.

***Caloneis bryophila* Manguin ex Kociolek & Reviere**

Page 25, pl. 4, fig. 7

Sample: 10

Holotype: AD7632

Descriptio: *Valvae lineares-lanceolatae polis rotundatis-obtusis, 32.5 µm longae, 5.5 µm latae. Raphe recta simplex ramis leniter curvis prope poros centrales. Area axialis lanceolata circa dimidium latitudinis valvae occupans; area centralis vittiformis transver-*

saliter extensa, latera valvae attingens. Striae medianae convergentes, radiales extremitates versus, circa 13 in 10 μ m, linea longitudinali hyalina sectae.

Description: Valves linear-lanceolate, rounded-obtuse at the poles, length 32.5 μ m, breadth 5.5 μ m. Raphe straight, simple and branches weakly incurved towards the central pores. Axial area lanceolate occupying to slightly near half the valve breadth. Central area transversely expanded to the valve margin in a subquadrate band. Median striae convergent becoming radial towards the extremities, about 13 in 10 μ m, crossed by a hyaline longitudinal line.

***Caloneis clevei* Lagerstedt var. *intermedia* Manguin ex Kociolek & Reviere**

Page 25, pl. 4, fig. 8

Samples: 1, 7, 11

Holotype: AD7668

Description: *Valvae lineares-lanceolatae, constrictae-capitatae ad extremitates, polis rotundatis-obtusis, 28-31 μ m longae, 5.5-6 μ m latae. Area axialis late lanceolata; area centralis quadrata insigniter alta. Striae radiales manifeste convergentes ad extremitates, circa 24-26 in 10 μ m.*

Description: Valves linear-lanceolate, constricted capitate at the extremities with rounded-obtuse poles, length 28-31, breadth 5.5-6 μ m. Axial area broadly lanceolate. Central area noticeably high, quadrate. Radial striae clearly convergent at the extremities, about 24-26 in 10 μ m.

***Caloneis neocaledonica* Manguin ex Kociolek & Reviere**

Page 26, pl. 4, fig. 9a, b

Sample: 4

Holotype: AD7661

Description: *Valvae lineares manifeste constrictae in parte mediana, manifeste dilatatae extremitates versus, polis rotundatis-cuneiformibus, 97-100 μ m longae, 17-18 μ m latae. Raphe recta ramis aliquantum curvis prope poros centrales. Area axialis lanceolata; area centralis vittiformis rectangularis usque ad latera valvae extensa. Striae omnes radiales, 12-13 in 10 μ m, linea hyalina longitudinali sectae.*

Description: Valves linear, clearly constricted in the median part, then noticeably enlarged towards the extremities, poles rounded-cuneiform, length 97-100 μ m, breadth 17-18 μ m. Raphe straight, with branches somewhat slightly inflected towards the central pores. Axial area lanceolate, central area expanded to the valve margin in a rectangular band. Striae entirely radial, 12-13 in 10 μ m, crossed by a hyaline longitudinal line.

***Amphora imperfecta* Manguin ex Kociolek & Reviere**

Page 26, pl. 4, fig. 10

Sample: 2

Holotype: AD7666

Description: *Aspectus valvaris: valva latere dorsali valde convexo, latere ventrali leniter convexo, abrupte constricta et capitata ad extremitates. Poli late rotundati et flexi lateris*

ventrale versus. Longitudo valvae 24.5 µm, latitudo 5 µm. Raphe ramis oblique spectantibus latus dorsale versus et deflexis ad poros centrales. Area axialis parvula in latere dorsali, in latere ventrali expansa fere usque ad marginem. Area centralis effecta in latere dorsali. Striae dorsales circa 18 in 10 µm, lineis 3-4 longitudinalibus hyalinis sectae; striae punctulosae circum aream centralem; striae ventrales parvulae, circa 25-26 in 10 µm.

Description: The few rare examples of this new *Amphora* have only been observed, after assembly in Pleurax, in valve view; it is strongly arched on the dorsal margin and weakly convex on the ventral margin, abruptly constricted and capitate at the extremities, the poles are broadly rounded and obliquely incurved on the ventral side, length 24.5 µm, breadth 5 µm. Raphe branches run obliquely towards the dorsal side and bend towards the central pores. Axial area very reduced on the dorsal border, expanded almost to the margin of the ventral side, central area developed on the dorsal side. Dorsal striae about 18 in 10 µm, crossed by 3-4 hyaline longitudinal lines, striae surrounding the central area are finely punctate; ventral striae very reduced, about 25-26 in 10 µm.

***Cymbella angustata* (Wm. Smith) Cleve f. *integra* Manguin ex Kociolek & Reviere**

Page 26, pl. 4, fig. 11

Samples: 3, 5, 6, 7, 16, 18

Holotype: *AD7670

Descriptio: *Valvae naviculares ad lineam medianam leniter asymmetricae, lanceolatae, minime attenuatae et non rostratae-capitatae ad extremitates similiter atque speciem, 30-51 µm longae, 6-8 µm latae. Striae radiales, circa 16 in 10 µm, densiores ad extremitates, 23 in 10 µm.*

Description: Valve naviculiform, weakly asymmetrical to the median line, lanceolate, hardly narrowed and non rostrate-capitate at the extremities like the species, length 39-51 µm, breadth 6-8 µm, radial striae, about 16 in 10 µm, more condensed at the extremities, 23 in 10 µm.

***Cymbella delicatula* Kützinger f. *lata* Manguin ex Kociolek & Reviere**

Page 27, pl. 5, fig. 3

Sample: 7

Holotype: AD7668

Descriptio: *Valvae asymmetricae, lanceolatae et minime extensae ad extremitates, 30 µm longae, 6 µm latae. Striae radiales, medianae dorsales 17 in 10 µm, ventrales 20 in 10 µm, usque ad 28 et plus in 10 µm extremitates versus.*

Description: Valves asymmetrical, lanceolate and very slightly constricted at the extremities, length 30 µm, breadth 6 µm, striae radial, the median striae on the dorsal side 17 in 10 µm, on the ventral side 20 in 10 µm, reaching 28 and more in 10 µm at the extremities.

***Cymbella delicatula* Kützing f. *obtusa* Manguin ex Kociolek & Reviere**

Page 27, pl. 5, fig. 4

Samples: 2, 6, 8, 12, 16

Holotype: *AD7641

Description: *Valvae minus asymmetricae quam illae speciei, lanceolatae, polis latius rotundatis-obtusis, 35 µm longae, 6.5 µm latae; striae radiales, medianae dorsales 15 in 10 µm, ventrales 17 in 10 µm, terminales 23-25 in 10 µm.*

Description: Valves less asymmetrical than the species, lanceolate with very broadly rounded-obtuse poles, length 35 µm, breadth 6.5 µm, striae radial, the median dorsal striae 15 in 10 µm and the ventral striae 17 in 10 µm. Terminal striae 23-25 in 10 µm.

Comment: This type is from sample 17.

***Cymbella hugonii* Manguin ex Kociolek & Reviere**

Page 27, pl. 4, fig. 13

Sample: 13

Holotype: AD7663

Description: *Valvae naviculares symmetricae, lanceolatae et anguste extensae ad extremitates, 22 µm longae, 4 µm latae. Raphe recta. Area axialis anguste lanceolata area centrali non manifesta. Striae omnes radiales, in utroque latere valvae numero aequales, circa 20-23 in 10 µm.*

Description: Valves with naviculoid symmetry, lanceolate and narrowly elongated at the extremities, length 22 µm, breadth 4 µm. Raphe straight. Axial area narrowly lanceolate without the appearance of a central area. Striae entirely radial and the same number on the two sides of the valve, about 20-23 in 10 µm.

***Cymbella neocaledonica* Manguin ex Kociolek & Reviere**

Page 28, pl. 5, fig. 6a, b

Sample: 17

Holotype: *AD7647

Description: *Valvae asymmetricae, lineares-lanceolatae, aliquantum extensae et interdum subrostratae ad extremitates, 24-34 µm longae, 5-5.5 µm latae. Raphe recta, leviter curva prope poros centrales. Area axialis anguste lanceolata, aliquantum dilatata in latere dorsali noduli centralis. Striae radiales 13-14 in 10 µm, subtiliter lineatae, terminales densiores et convergentes.*

Description: Valves asymmetrical, linear-lanceolate, noticeably elongated and sometimes subrostrate at the extremities, length 24-34 µm, breadth 5-5.5 µm. Raphe straight, lightly curved towards the central pores. Axial area narrowly lanceolate, somewhat enlarged on the dorsal border of the central nodule. Radial striae 13-14 in 10 µm, finely lineate, the terminal striae more condensed and convergent.

***Cymbella suburgida* Hustedt in Schmidt et al. var. *neocaledonica* Manguin ex Kociolek & Reviere**

Page 28, pl. 5, fig. 7a, b

Samples: 14, 18

Holotype: AD7669

Description: *Valvae asymmetricae lanceolatae, lateribus convexis quorum altero ventrali minus convexo et interdum aliquantum tumido in medio, extremitatibus rotundatis-acutis, 36-49 µm longae, 8-9.5 µm latae. Striae valde radiales, in utroque latere numero aequales, circa 10 in 10 µm, 13 in 10 µm extremitates versus, manifeste lineatae. Praeterea characteres omnes alii varietatis nostrae eadem ac varietas wallaceana Hust. (1942, p. 105, fig. 222 ad 224) sunt, praeter raphen concomitam lineam manifestam quae in figuris originalibus auctoris non picta est.*

Description: Asymmetrical lanceolate valves, convex at the margins, the ventral margin to a lesser degree and sometimes slightly tumid about the middle, valve extremities rounded-acute, length 36-49 µm, breadth 8-9.5 µm. Striae strongly radial, the same number on both sides, about 10 in 10 µm, at the extremities 13 in 10 µm, distinctly lineate. Furthermore, all the other characters of this variety are identical to var. *wallaceana* Hust. An exception being the raphe, which is provided with a quite apparent accompanying line, this line is not figured in the original figures of the author.

***Cymbella tenuissima* Hustedt var. *semiradiata* Manguin ex Kociolek & Reviere**

Page 29, pl. 4, fig. 14

Samples: 17, 18

Holotype: AD7669

Description: *A specie (F. Hustedt, 1942, p. 100, fig. 210-203) striis dorsalibus manifeste radialibus differt. Longitudo valvarum 20.5 µm, latitudo 3.5-4 µm. Striae circa 32-34 in 10 µm, paulum dissitiores in medio lateris dorsalis, omnes raphe perpendiculares in latere ventrali.*

Description: Differs from the species by its clearly radial dorsal striae, length of the valves 20.5 µm, breadth 3.5-4 µm, about 32-34 striae in 10 µm, slightly more spaced on the median dorsal side, on the ventral side striae are entirely perpendicular to the raphe.

***Gomphonema bourrellyi* Manguin ex Kociolek & Reviere**

Page 29, pl. 5, fig. 9

Samples: 13, 14, 16, 18

Holotype: AD7663

Description: *Valvae lineares-lanceolatae, polo capitali quam pedali latiore, pariete polari satis manifesto, 43.5-70 µm longae, 6-7 µm latae. Raphe recta linea paulo manifesta concomitata. Area axialis lanceolata; area centralis circularis sine stigmate. Striae radiales punctis sublinearibus ad subpunctiformibus, 9-11 in 10 µm. Rima polaris capitalis in area terminali hyalina locata.*

Description: Valves linear-lanceolate with the headpole broader than the footpole, polar partition fairly apparent, length 43.5-70 µm, breadth 6-7 µm. Raphe straight with

an accompanying line slightly apparent. Axial area lanceolate, central area circular without an isolated point. Striae radial in subpunctiform dashes, 9-11 in 10 μm . Slit at the headpole situated in a terminal hyaline area.

Comment: Moser *et al.* (1995) described a new diatom, *Gomphonema neobourrellyi* Moser & Lange-Bertalot, and listed *G. bourrellyi* as a synonym with a "?".

***Gomphonema neocaledonica* Manguin ex Kociolek & Reiers**

Page 30, pl. 5, fig. 10a, b

Samples: 3, 12, 16, 17

Holotype: AD7646

Description: Valvae longe lineares-lanceolatae, polo capitali quam pedali latius rotundato-obtusae, 40-75 μm longae, 5.5-7.5 μm latae. Raphe recta linea manifestissima concomitata. Poris centralibus latus versus curvis. Area axialis lanceolata; area centralis elliptica paulo plus quam dimidium longitudinis medianae valvae occupans, sine stigmatibus. Striae radiales, 9-11 in 10 μm , manifeste punctatae, punctis circa 20-25 in 10 μm . Striae terminales poli capitalis rimam polarem anguste cingentes.

Description: Valves elongate linear-lanceolate, headpole more broadly rounded-obtuse than the footpole, length 40-70 μm , breadth 5.5-7.5 μm . Raphe straight with an accompanying line quite apparent, central pores laterally recurved. Axial area lanceolate, central area elliptical occupying slightly more of the middle of the median breadth of the valve, without an isolated point. Striae radial 9-11 in 10 μm , clearly punctate, about 20-25 puncta in 10 μm . Terminal striae at the headpole narrowly surrounding the polar slit.

Comment: Moser *et al.* (1995) described a new diatom, *Gomphonema neobourrellyi* Moser & Lange-Bertalot, and listed *G. neocaledonica* as a synonym with a "?".

***Gomphonema opinum* Kociolek & Reiers**

(*G. simplex* Manguin nom. nud.)

Page 30, pl. 3, fig. 9

Sample: 8

Holotype: *AD7641

Description: Valvae ellipticae-lanceolatae, extensae et plus minusve rostratae ad subcapitatae ad extremitates, 12-13 μm longae, 3.5-4 μm latae. Area axialis angusta non dilatata circum nodulum centrale, sine stigmatibus. Striae radiales, circa 23 in 10 μm .

Description: Valves elliptical lanceolate, elongate and + rostrate to subcapitate at the extremities, length 12-13 μm , breadth 3.5-4 μm . Axial area narrowly not enlarged around the central nodule, without an isolated point. Striae radial, about 23 in 10 μm .

Comments: Use of the original epithet of Manguin (*G. simplex*) would make this name a later homonym of a species described by Kützinger (1833, p. 565, pl. 16, fig. 52). Although Van Landingham (1971) offered a new name, *G. simplex* Van Landingham, for Manguin's species, neither name has nomenclatural status, since the species did not have a valid description and type designation. The epithet *opinum* refers to the great abundance of this species in the sample from which it is described.

***Epithemia argus* (Ehrenberg) Kützing var. *lunaeformis* Manguin ex Kociolek & Reviere**

Page 30, pl. 6, fig. 1a, b

Sample: 18

Holotype: AD7670

Description: *Valvae lunares, latere dorsali valde convexo, latere ventrali leniter concavo, 78-80 µm longae, 14-15 µm latae. Canalis raphes manifestus solum in parte mediana valvae, ramis latus ventrale versus leniter curvis, angulum latissimum formantibus, attingentem paulo plus quam dimidium latitudinis axis transapicalis. Series areolarum 7-9 in 10 µm; parietes interni robustissimi, 1-2 in 10 µm.*

Description: Valves in the form of a lunar crescent, strongly curved along the dorsal side, weakly concave along the ventral side, length 78-80 µm, breadth 14-15 µm. Raphe canal clearly apparent in the median part of the valve, with branches weakly curved in the direction of the ventral margin, forming an angle very open reaching slightly more than half of the breadth of the transapical axis. 7-9 rows of areolae in 10 µm; internal partitions very robust 1-2 in 10 µm.

***Nitzschia hiengheneana* Manguin ex Kociolek & Reviere**

Page 32, pl. 6, fig. 5

Sample: 11

Holotype: AD7672

Description: *Valvae lineares-lanceolatae, latere ventrali leniter concavo, attenuatissimae productaeque prope polos rotundatos-acutos, 18-19 µm longae, 3-3.5 µm latae. Puncta carinalia robusta, duo mediana quam alia distantiora, 10-12 in 10 µm. Striae lineis longitudinalibus hyalinis sectae; striae transapicales circa 19-25 in 10 µm.*

Description: Valves linear-lanceolate with ventral margin lightly concave, very small and produced near the rounded-acute poles, length 18-19 µm, breadth 3-3.5 µm. Keel puncta robust, the two median ones more distant than the neighboring ones, 10-12 in 10 µm, striae crossed by hyaline longitudinal lines, about 19-25 transapical striae in 10 µm.

***Nitzschia luzonensis* Hustedt f. *brevior* Manguin ex Kociolek & Reviere**

Page 32, pl. 6, fig. 6

Sample: 1

Holotype: *AD7648

Description: *Valvae lanceolatae ad extremitates acutae, 14-15 µm longae, 2-2.5 µm latae. Puncta carinalia 9-10 in 10 µm. Striae 26-30 in 10 µm.*

Description: Valves lanceolate, acute at the extremities, length 14-15 µm, breadth 2-2.5 µm, 9-10 keel puncta in 10 µm, striae 26-30 in 10 µm.

***Nitzschia neocaledonica* Manguin ex Kociolek & Reiers**

Page 32, pl. 6, fig. 7a, b

Sample: 11

Holotype: *AD7672

Descriptio: *Valvae ellipticae-lanceolatae ad lineares-lanceolatae, manifeste constrictae-capitatae ad extremitates, 13-30 µm longae, 3-4 µm latae; puncta carinalia 10-13 in 10 µm; striae invisibiles.*

Description: Valves elliptical-lanceolate to linear-lanceolate, clearly constricted-capitate at the extremities, length 13-30 µm, breadth 3-4 µm, 10-13 keel puncta in 10 µm, striae invisible.

***Nitzschia subbacata* Manguin ex Kociolek & Reiers**

Page 32, pl. 7, fig. 4

Sample: 11

Holotype: *AD7673

Descriptio: *Valvae angustae longe lineares-lanceolatae, extremitatibus modice acutis, polis non capitatis, 108-110 µm longae, 3.5-4 µm latae. Puncta carinalia diminitissima 10-12 in 10 µm, punctis duobus medianis quam aliis non distantioribus. Striae invisibiles.*

Description: Valves narrow elongated linear-lanceolate, extremities fairly acute with non-capitate poles, length 108-110 µm, breadth 3.5-4 µm. Keel puncta very shortened, 10-12 in 10 µm, the 2 median keel puncta are noticeably displaced and larger. Striae invisible.

***Nitzschia vitraea* Norman var. *tenuistriata* Manguin ex Kociolek & Reiers**

Page 33, pl. 6, fig. 8a, b

Sample: 10

Holotype: AD7633

Descriptio: *Valvae striis quam illis speciei densioribus minimum 30-35 in 10 µm, punctis carinalibus circa 5 in 10 µm, extremitatibus valde capitatis.*

Description: Valves with striae more constricted than the species, 30-35 in 10 µm, keel puncta about 5 in 10 µm, valve extremities strongly capitate.

***Surirella neocaledonica* Manguin ex Kociolek & Reiers**

Page 33, pl. 7, fig. 6a, b

Samples: 6, 7

Holotype: AD7668

Descriptio: *Frustulum axe apicali isopolari. Valvae ellipticae ad lineares-ellipticae, polis late rotundatis, 49-90 µm longae, 16-22 µm latae. Area mediana anguste lanceolata sine pseudoraphe visibili. Alae angustae paulo manifestae, interdum indistinctae, sine prominentia alari visibili. Canales angusti, 30-40 in 10 µm. Superficies valvaris leniter undulata, partibus depressis et elevatis undularum latitudine inaequalibus. Membrana cellularis manifeste striata, striis circa 25-30 in 10 µm.*

Description: Frustule with apical axis isopolar. Valves elliptical to linear-elliptical, with poles broadly rounded, length 49-90 µm, breadth 16-22 µm; median zone narrowly lanceolate without the appearance of a pseudoraphe. Wings narrow and slightly apparent, sometimes indistinct, with alar projections visible. Canals narrow, 30-40 in 100 µm. Valve surface weakly undulate, depression and summit of the undulations of unequal breadth. Cell membrane distinctly striated, striae about 25-30 in 10 µm.

Comment: Moser *et al.* (1995) designated a neotype (PC, Collection Maillard No. 16/1, Riviere Ouenkohn) for this taxon, but did not provide a validating description.

***Surirella pseudomargaritifera* Manguin ex Kociolek & Reviere**

Page 33, pl. 7, fig. 7

Sample: 4

Holotype: AD7662

Descriptio: Frustulum axe apicali isopolari. Valvae ovaes polis late rotundatis, 30 µm longae, 13 µm latae. Prominentiae alares indistinctae. Canales circa 40 in 100 µm. Ondulae (costae) a lateribus valvae usque ad aream centralem extensae, partibus depressis et elevatis undularum latitudine plus minusve aequalibus. Sine pseudoraphe visibili. Membrana cellularis manifeste striata in partibus elevatis undularum, striae circa 30 in 10 µm. Praeterea, membrana spinis parvis omnino instructa.

Description: Frustule with apical axis isopolar. Valves oval with broadly rounded poles, length 30 µm, breadth 13 µm. Alar projections indistinct, canals about 40 in 100 µm. Undulations (ribs) stretch from the valve margin to as far as the central zone, depression and summit of the undulations slightly close to equal breadth. The pseudoraphe is not apparent. Cell membrane visibly striated to the summit of the undulations, about 30 striae in 10 µm. On the outside the membrane is garnished entirely with small spines.

***Surirella spinifera* Hustedt var. *armata* Manguin ex Kociolek & Reviere**

Page 34, pl. 7, fig. 8

Samples: 3, 4, 6, 7, 8

Holotype: AD7654

Descriptio: Frustulum axe apicali heteropolari. Valvae oviformes-elongatae, polis cuneiformibus-rotundatis, latitudine paulo longiore quam triente axis apicalis, 103-184 µm longae, 39-57 µm latae. Area mediana lanceolata pseudoraphe manifestissima instar cristae munitae spina longa robustaque ad extremitatem utramque. Prominentiae alares absunt, itaque canales fenestraeque in lateribus valvae non visibiles sunt. Superficies valvae a lateribus usque ad aream centralem undulata, undulis circa 15-20 in 100 µm, in medio perpendicularibus linea mediana, polos versus radialibus. Membrana cellularis subtilissime striata, spinis parvis manifestis instructa in depressionibus undularum.

Description: Frustule with apical axis heteropolar. Valves ovoid-elongate, with poles cuneiform-rounded, the valve reaching in the greatest breadth slightly more than a third of the length of the apical axis, length 103-184 µm, breadth 39-57 µm. Median zone lanceolate with the pseudoraphe quite apparent in that the crest is armed at the two extremities with a long and robust spine. Alar projections absent, a consequence of canals and fenestrae not appearing on the border of the valve. Surface of the valve

undulation from the margin to the median zone, about 15-20 undulations in 10 µm, perpendicular to the median line in the middle, radial towards the poles. Cell membrane finely striated, covered by small spines easily visible in the depressions of the undulations.

Comment: Moser *et al.* (1995) designated a neotype (PC, Collection Maillard No. A5, Source, Ile des Pins) for this taxon, but did not provide a validating description.

ACKNOWLEDGEMENTS - This project was funded in part through an invited professorship to JPK from the Muséum National d'Histoire Naturelle, Paris. Drs Richard Moe, University of California, Berkeley, and Horst Lange-Bertalot, J.W. Goethe-Universität, provided constructive reviews. Dr Paul Silva, University of California, Berkeley, kindly provided access to the *Index Nominum Algarum*.

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Commission paritaire 16-4-1987 - N° 60590 - Dépôt légal 3^e trimestre 1996 - Imprimerie F. Paillart
Sortie des presses le 31 juillet 1996 - Imprimé en France
Éditeur : A.D.A.C. (Association des Amis des Cryptogames)
Président : D. Lamy ; Secrétaire : B. Denetiere
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